# FLIGHT

and The AIRCRAFT ENGINEER

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

Editor
C. M. POULSEN

Managing Editor
G. GEOFFREY SMITH

Chief Photographer
JOHN YOXALL

Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1

Telegrams: Truditur, Sedist, London. Telephone: Waterloo 3333 (50 lines).

8-10, CORPORATION ST., COVENTRY. Telegrams: Autocar, Coventry. Telephone: Coventry 5210.

GUILDHALL BUILDINGS, NAVIGATION ST., BIRMINGHAM, 2. Telegrams: Autopress, Birmingham. Telephone: Midland 2971 (5 lines).

260, DEANSGATE, MANCHESTER, 3. Telegrams: Iliffe, Manchester. Telephone: Blackfriars 4412.

26B, RENFIELD ST., GLASGOW, C.2. Telegrams: Iliffe, Glasgow. Telephone: Central 4857.

SUBSCRIPTION RATES: Home and Canada: Year, £2 6 0. 6 months, £1 3 0. 3 months, 11s. 6d. Other Countries: Year, £2 9 0. 6 months, £1 4 6. 3 months, 12s. 3d.

No. 1635. Vol. XXXVII. APRIL 25, 1940 Thursdays, Price 9d.


# The Outlook

## The Bombing of Stavanger

UP to the time when the Navy mined practically every bit of water where a German vessel might want to steam, the function of the Royal Air Force was co-operation with the Navy. With the attacks on Stavanger aerodrome and seaplane base the work of the R.A.F. may be said to have entered upon a new phase. In so far as Stavanger might be used as a base for raids on Britain, our bombing and bombarding attacks on it may be classed as naval and naval co-operation work. The Fleet has, in fact, supplemented the efforts of the R.A.F. for the general advantage of British interests in the war. But in bombing Stavanger the Air Force is, for the first time in this war (for Sylt was an isolated demonstration), pursuing a definite bombing policy against land in occupation of the enemy. For the moment the struggle is mainly between the *Luftwaffe* and the R.A.F., the former trying to make good its occupation of Stavanger, and the latter trying to make the place uninhabitable for it.

This tussle may, however, be a stepping stone to a new phase of the war in the air; for if the *Luftwaffe* were able to mass its strength at Stavanger it would become a menace to the contingents of the British Army which have landed at various points on the Norwegian coast. It should have been the duty of the *Luftwaffe* to interfere with that landing if it had been able to do so. Its next duty should be to attack our Expeditionary Force before it has established itself with adequate anti-aircraft defences. So far as we know, the German aircraft have not damaged our troops, and the chief reason for that must be that the chief German air base in Norway has been immobilised by the constant harassing to which it has been subjected. In that way the rôle of the Air Force is changing into help for our Army. That rôle may well develop.

## Aalborg

THE suggestion made in these columns last week that Aalborg aerodrome would prove of importance to the Germans in their transport by air of troops to Norway has proved correct. We also pointed out that Aalborg could be bombed by the R.A.F., and it has already met that fate. In fact all the aerodromes, except Oslo, on which the Germans have had to rely for the reinforcement of their men in Norway are within reach of British bombers, and the Bomber Command, helped by the Coastal Command and the Fleet Air Arm, has not been slow to take advantage of that fact. It is a really parlous position for the German invaders that they do not command the sea, and in trying to use the air as a substitute they can only rely on aerodromes which are under the fire of their opponents.

At the best, reinforcement by air is a very poor substitute for reinforcement by sea, because modern warfare demands heavy and bulky weapons, such as big guns and tanks together with innumerable large lorries, none of which can be transported by air. In the mountainous parts of Norway there is the less need for such heavy weapons, but we must suppose that the final stages of this campaign will be fought out on the level regions in the South East of the country, and there the heavy weapons will come into their own.

In the meantime we would express our regret that Aalborg has to be knocked about by British bombs. Less than a year ago we published an article describing a flying tour by a member of *Flight's* staff over Denmark, which included a landing at Aalborg. The people of that city, and in particular the editors and journalists, gave the party a most hospitable welcome, and some warm friendships were made there. Our representative was much impressed by the plucky attempt of the Danish Air Lines to keep that form of

transport going in the face of considerable difficulties. Aalborg aerodrome was a humble place compared with the fine airport of Kastrup, outside Copenhagen, but it was sufficient for its purpose, and seemed to have a future. The modest buildings on it have now received the attention of British bombers, and there is pathos in that thought.

## *Is Wright Right?*

MR. THEODORE P. WRIGHT has been guessing again. We feel sure he will not mind us applying this expression to his attempt to forecast the future from fairly ancient knowledge of reasonably good authenticity and more recent knowledge of doubtful validity. In short, Mr. Wright has tried to evaluate production rates and air strengths of the Allies and Germany.

Mr. Wright is a very shrewd observer, as those who had the good fortune to meet him during his visits to England will know. And his position in the great Curtiss-Wright Corporation is sufficient guarantee of his technical ability. When, therefore, he sets out to estimate things like total aircraft output, he may be expected to take every care possible. He would certainly not associate his name with pure speculation. But the fact, admitted by him, that assumptions of somewhat doubtful character have had to be made does introduce a very fair amount of guesswork.

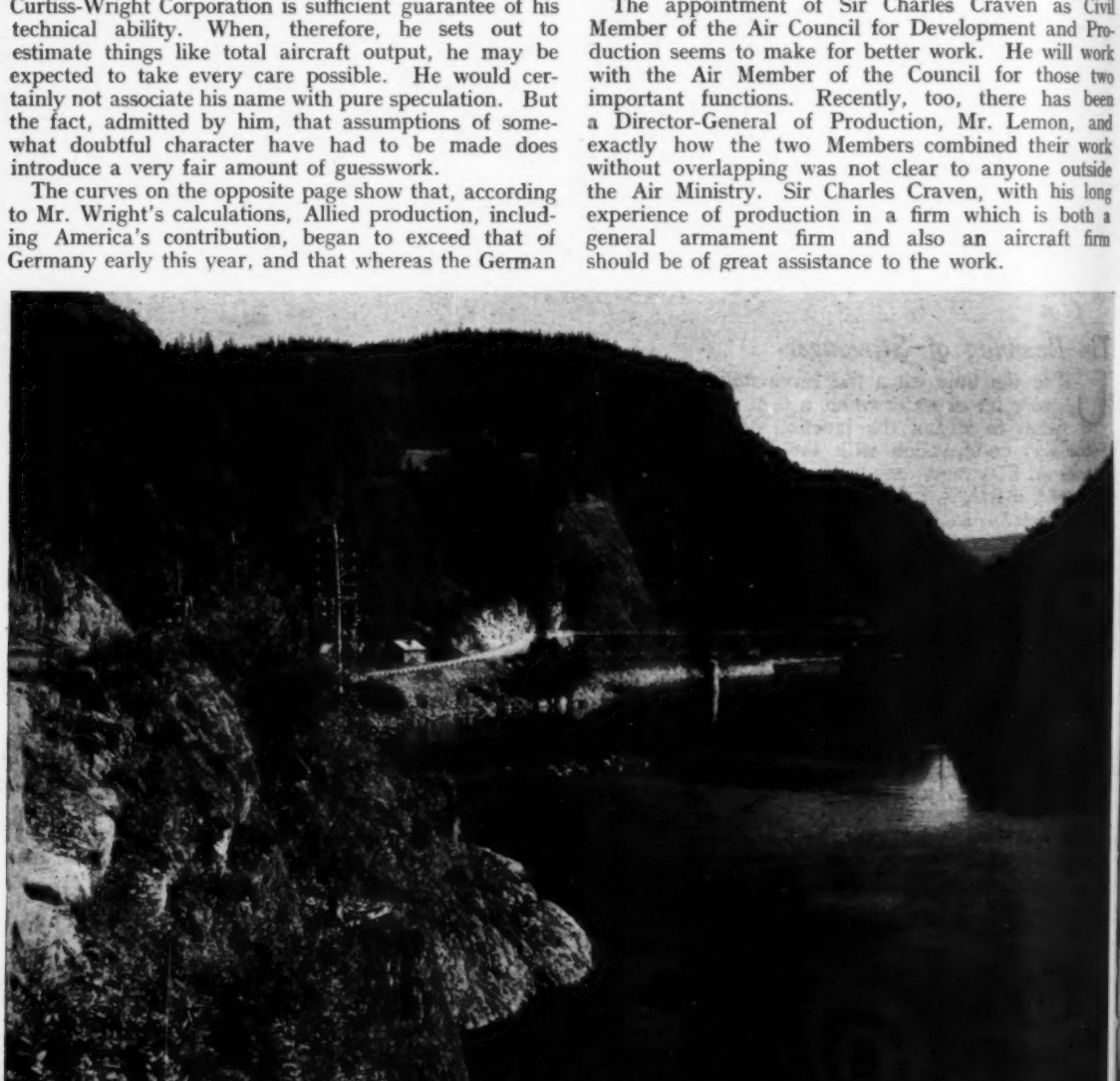
The curves on the opposite page show that, according to Mr. Wright's calculations, Allied production, including America's contribution, began to exceed that of Germany early this year, and that whereas the German curve begins to flatten out, the Allied curve continues almost straight.

In total air strength the figures should be even by the spring of next year, but if Mr. Wright's estimate of losses is correct, the Allies look like having a bad time of it towards the end of the present year. Experience so far has not indicated this trend, but "total" war has not started, and no man can say whether it ever will. It leads only to senseless destruction on both sides without benefiting either.

## *New Appointments*

THE appointment of a Vice-Chief of the Air Staff, as well as Vice-Chiefs of the Naval and Imperial General Staffs, seems a common-sense measure in these times of stress. Air Chief Marshal Sir Cyril Newall must have been worked almost to death. Now Air Marshal Peirse will be able to relieve him of attendance at War Cabinet meetings, which must take up much time.

The appointment of Sir Charles Craven as Civil Member of the Air Council for Development and Production seems to make for better work. He will work with the Air Member of the Council for those two important functions. Recently, too, there has been a Director-General of Production, Mr. Lemon, and exactly how the two Members combined their work without overlapping was not clear to anyone outside the Air Ministry. Sir Charles Craven, with his long experience of production in a firm which is both a general armament firm and also an aircraft firm should be of great assistance to the work.



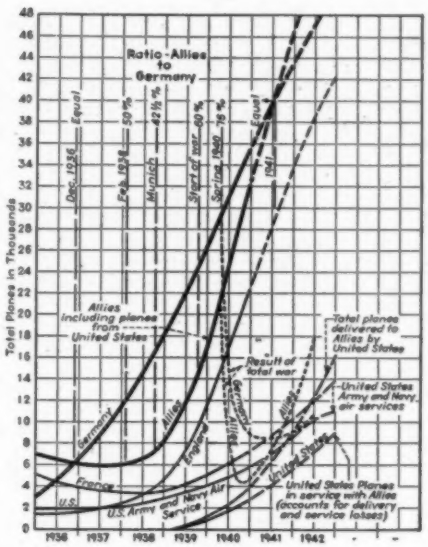
"*Flight*" *photograph*

**IN THE NEWS THIS WEEK: A bridge over Kaporals River, near Stören, 30 miles south of Trondhjem. The destruction of the bridge would effectively block the main road from Trondhjem to Oslo.**

# AIR STRENGTHS

## *An American Engineer Predicts Allied Victory*

WE publish, by courtesy of *Aviation*, a short summary of an article on that vital subject, the comparative air strengths of the Allies and Germany. The author, Mr. T. P. Wright, is vice-president of engineering of the Curtiss-Wright Corporation in U.S.A., and inspected aircraft factories in England, France and Germany during visits in 1934, 1936, 1937 and 1938. Though Mr. Wright's opinions carry some weight, to obtain the true picture of this difficult subject is almost an impossibility, and the statements made in the article are not necessarily the opinions of *Flight*. It is also of interest that the official view in this country of the German rate of production is that 2,000 aeroplanes per month is an exaggeration.—Ed.



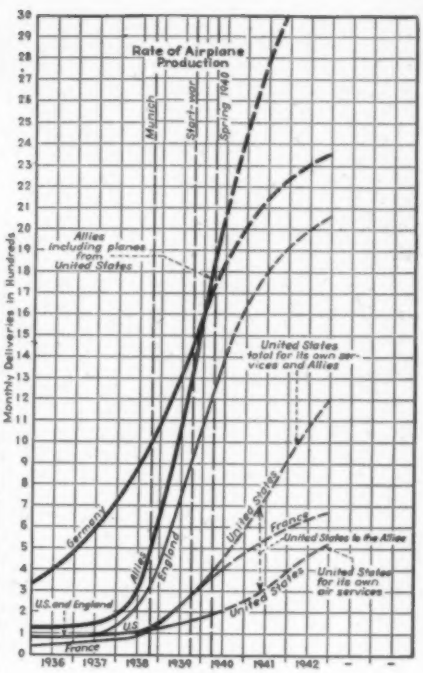




**Fig. 1 (above) shows rates of aircraft production.**

**Fig. 2 (left) shows total air strengths.**

One object of this article is to arrive at probable present air strengths, accomplished by building up through the past several years from rates of production on which quite accurate information is available. The figures obtained have been checked against the most logical of the current estimates and the curves here shown are the result.

### *Assumptions and Methods*

Censorship has for some time prohibited the printing of direct information on actual rates of production. Frequently, however, information on floor space, labour force, appropriations, and other such data has appeared and has made possible the working out of production rate figures by the use of constants developed on the basis of known actual practice in this country. These constants follow:—

**MISCELLANEOUS CONSTANTS FOR COMPUTATION**

| Item | Unit | Aeroplane Structure | Engine and Propeller |
|---|---|---|---|
| Concentration ... ... | Square Feet per Man ... | 100 | 204 |
| Money Value ... ... | Dollars per Sq. Ft. per Year | 56 | 49 |
| Money Value ... ... | Dollars per Man per Year ... | 5,600 | 10,000 |
| Money Value (Approx. Average) | Dollars per Pound ... ... | 7.5 | 7.5 |
| Weight Value ... ... | Pounds per Sq. Ft. per Year | 7.5 | 6.5 |
| Weight Value ... ... | Pounds per Man per Year ... | 750 | 1,340 |

It is assumed:—

1—that capacity conditions, which are approximately two full day shifts, maintain.

2—that all-metal type of aeroplane structure is used.

3—that average size of aeroplane orders are lots of 400; and that engine and propeller factories are operating near capacity.

4—that a profit margin of 10 per cent. is realised.

5—that labour average rates are:—

aeroplane factory ..... $70/hr.
engine factory ..... $80/hr.

6—that aeroplane structure weight is equal to gross weight less useful load and less weight of engine, propeller and instruments.

7—that floor space includes stockroom but excludes office space.

As a sample of the method used, the following examples are given:—

"A"—How near is the American aircraft industry to its capacity?

Aeroplanes: With about 8,250,000 sq. ft. of floor space and 60,000 workmen, we have 137.5 sq. ft. per man and therefore are 73 per cent. capacity, which is estimated to be 100 sq. ft. per man.

Engines and propellers: With about 3,500,000 sq. ft. of floor space and 16,000 workmen, we have 218 sq. ft. per man and therefore are 94 per cent. capacity, which is estimated to be 204 sq. ft. per man.

"B"—What is the current production rate of aeroplanes in Germany?

When averaging several sources one obtains a figure of 400,000 men in the German aircraft industry, including the sub-contracting units. In our industry we have 100,000. We might then expect Germany's production rate to be four times our own. But her production lots average greater than ours, perhaps twice as many, making possible a greater output per man. Using .90 for this factor, we obtain 4.44 times our output which appears to approximate the facts.

Analyses of this kind are admittedly approximations, but when figures obtained by many different methods of approach are checked and rechecked, and when a fair degree of judgment is exercised, final answers near the truth should result.

After due consideration of the information and the need for caution in interpreting such data, the curves of Fig. 1 have been produced to show the monthly deliveries that have maintained since January, 1936, and projected from the present time through 1942. The rather constant increase in rate of production of Germany since 1936, with her substantial lead over the Allies at that time, is noteworthy. The slow start which the Allies and the U.S. made and the relatively small production extending well into 1938, coupled with rapid increase of rate of production in Enland subsequent to 1938, are also important.

Here I would like to emphasise the magnificent comeback that England has made in the air after a very slow

and muddling start. One should also note the rapid increase in assistance to the Allies from the United States which may be expected to maintain from now on, even while building up the rate of delivery under our production programme as required to meet our own Air Force expansion needs. But, compared to England and Germany, our production is still small.

### *Relative Proportions*

The method used to obtain the curves shown in Fig. 2 is the following: A start is made in January, 1936, with an estimated air strength for each country. Then, the strength for each succeeding year is estimated by increasing for that year each country's air force by the amount obtained by integrating the curves of Fig. 1 and then reducing by an amount estimated to take care of obsolescence and wastage due to crashes or other causes of loss.

It has been found that in this country the yearly depreciation of the air force is approximately 22 per cent. in normal times, probably somewhat less during a period of rapid expansion. In determining depletion for European countries during the period 1936 to date, varying rates of depreciation were used, depending on particular circumstances which were found to maintain as regards rate of obsoleting equipment, rate of training and probable resultant crashes, both in training and service. The figures average from about 25 per cent. per year in 1936 to 45 per cent. per year by January, 1940. This, it should be noted, is a monthly rate of depreciation of from two per cent. to about four per cent. At the present time, March, 1940, with relatively minor air activity, it is not believed that the depletion is more than five per cent. per month, judging from the published losses of the various belligerents, coupled with the other factors cited above.

It should be noted that the curves of Fig. 2 cover total planes of all types, including first-line, reserve, co-operation and training. However, the proportion each class of plane bears to the total approximates these percentages: First line, 30 per cent.; reserve, 20 per cent.; co-operation, 20 per cent.; training, 30 per cent. But Germany, an aggressor, emphasises bombers; England, a defender, pursuits. During certain periods of expansion, trainers must be emphasised. Also, the proportions of first-line to reserve are affected by availability of pilots. It is believed, however, that the percentages given will not vary for any country by more than 15 per cent. of the values shown.

The curves for total air power have been extended beyond the present time, showing a tendency to flatten out as the estimated capacity of the country involved is approached.

### *Effect of "Total" War*

Shown in dotted lines on Fig. 2 are the effects on the total air power strength of the Allies and Germany which will maintain in the event of a "total" war in the air taking place. These curves have been derived by assuming continuing rate of production as given in Fig. 1 (as it is impossible to guess even the approximate falling off of production that might result from bombed aircraft factories), but assuming destruction of planes in service at the rate of 25 per cent. of total strength per month. In the event of a "total" war there may be reluctance on the part of Germany to dig too deeply into her oil, iron, and aluminium reserves. The curves portray (assuming that the "total" war starts this spring) that the air strength of the Allies will exceed that of Germany during the last half of 1941, although towards the end of 1940 there will be a dangerous disparity between the two air forces in favour of Germany. Strangely enough, in the event a "total" war does not start this spring, the relative strengths of the belligerents in the air will become equal only a couple of months earlier in 1941!

### *Quality*

Comment on this admittedly important subject will be restricted to the statement that, in the writer's belief, quality of equipment is, and will remain, substantially equal, but credit is given to the highly developed and effective power-controlled gun turrets with which many British bombing planes are equipped. It is not believed, however, that superiority in performance of equipment will so predominate on either side as to make this the determining factor. No one who has inspected German equipment and German research laboratories, and is aware of German general engineering and scientific ability, can believe the quality of her products from the performance standpoint is likely to be greatly exceeded. Similarly, one cannot feel that the Allies will trail in quality after viewing such notable English aircraft equipment as the Spitfire and the Hurricane.

It seems likely, therefore, that the eventual outcome of the war will be largely affected by the relative strength in the air that each side can muster. I feel that Germany's past supremacy and present small superiority in the air will be overcome by the Allies. The curves shown should approximate the situation. Assuming substantially equal land forces and land defences, and continuing Allied supremacy on the sea, and economic superiority for the Allies in access to world markets and in financial means of exchange, then, once air equality is attained, the outcome will not remain long in doubt. This time should arrive late in 1941 or early in 1942, and with it Allied victory.

The world has had to relearn a lesson the hard way: policy must always be backed by strength. This holds whether international affairs fall into the scheme of power politics or collective security. Collective security, in the form of the League of Nations, was tried after the last war. It proved insecure and failed since collective strength was not behind it. Realising the determining importance of air power, Germany secretly started her air rearming. She built up an efficient industry and then openly extended her air force and by threat of its use acquired much of what she wanted. If the world has learned the lesson sufficiently well, then after this war we may possibly hope to look forward to a more effective collective security. When backed by overwhelming air power, some future federation, or union, or league will possess a means of keeping the peace far superior to any yet devised. Then the aeroplane will assume a new dual role in civilisation: the most rapid means of transportation, for bringing people closer together, and the guardian of peace for enforcing and ensuring success of the next form of collective security.

---

## *U.S.A. Accident Statistics*

AIR transport in the United States has set a new record in safe operation. Between March 26, 1939, and March 26, 1940, the airlines have operated without one fatality. This is remarkable considering the volume of transport which has been flown, 814,906,250 passenger-miles and 87,325,145 aeroplane-miles. The passengers carried totalled 2,028,817.

Of course, by picking the period, one can get the most favourable accident rate, but the achievement cannot be dismissed so easily, even though other periods of American air transport have had their share of accidents. It is a magnificent record.

An analysis of accidents in private flying from January to June, 1939, shows that, of the 978 accidents, 62 per cent. were due to pilot error; 13, engine failure; 7, structural causes; 7, weather; and 11 per cent. doubtful and miscellaneous. Miles flown per accident were 74,297, with 95 fatal accidents, involving the deaths of 77 pilots and 77 passengers. Total fatalities, including third party, were 161. Miles flown per fatality, 451,320, was the best figure so far recorded, the figures for the three preceding years all being about 422,000.

## *The Me 112 and He 112 F*

FREQUENT references have been made in *Flight* to the possibilities of using the Messerschmitt Me 110 as a bomber. Our French contemporary, *Les Ailes*, has recently mentioned a machine designated the Me 112. This is said to be developed from the Me 110 and may be the machine (now called the Jaguar) illustrated on April 4 and 11.

It is also stated that the new version of the Heinkel He 112 single-seater fighter is known as the He 112 F. This machine differs considerably from the original model and is fitted with a Daimler-Benz D.B.601 engine. The designation HE 112 U may apply only to the machine in its speed-record form. An HE 112 has been reported over the Western front.

Ha 140 (TIITTI)

# CLASSIFYING AIRCRAFT

## *A Rapid Method of Recognising Types*

AIRCRAFT recognition is of such importance to-day that any scheme for facilitating identification and reporting is deserving of close study. We are indebted to our French contemporary *Revue de l'Armée de l'Air* for the following suggestion.

While it is recognised that identification charts are of great assistance, it is considered that their scope can be widened by the use of a code which will classify the silhouettes into small groups of aircraft, differing only in detail. Such a code must be adaptable for general use under all conditions and from all angles. It must be reliable, and while it could not be made foolproof it should be the one least subject to errors. As selectiveness is essential such points as the number of rudders and engines are particularly useful.

It often happens, when several factories are producing the same type in large quantities that minor variations are introduced. For example, radial engines might be used on some machines instead of in-line units, so that the type of engine cannot be so reliable a guide as the general outline of wings and fuselage. Another useful point is that, in machines of the same make, such parts as the fin and rudder often have a characteristic design which varies but little from type to type.

The last, but most important, requirement of a code is that it should be easy to remember. Messages would have to be sent in condensed form by telephone or telegraph and the possibility of any confusion must be minimised.

In the suggested code a group of six letters is adopted for reasons of simplicity. These are easy to remember even by the least technically minded and sufficient to form small separate classes of machines. Each code heading has only two alternatives. For example, single-engined or multi-engined, and not single-engined, twin-engined, three-engined, etc.

### *Significance of Letters*

The fixation of each heading is made by sending only one letter. The letter I means "single" and T means the opposite of this, i.e., single-engined = I, multi-engined = T. Because of the difference between these two letters in Morse the risk of confusion is minimised.

The following code headings are given in the order of their use:—

E: number of engines (one = I; multi = T).

F: position of fuselage in relation to wing (above = I; below = T).

W: number of wings (monoplane = I; multiplane = T).

U: undercarriage (retracting = I; fixed (or floats) = T).

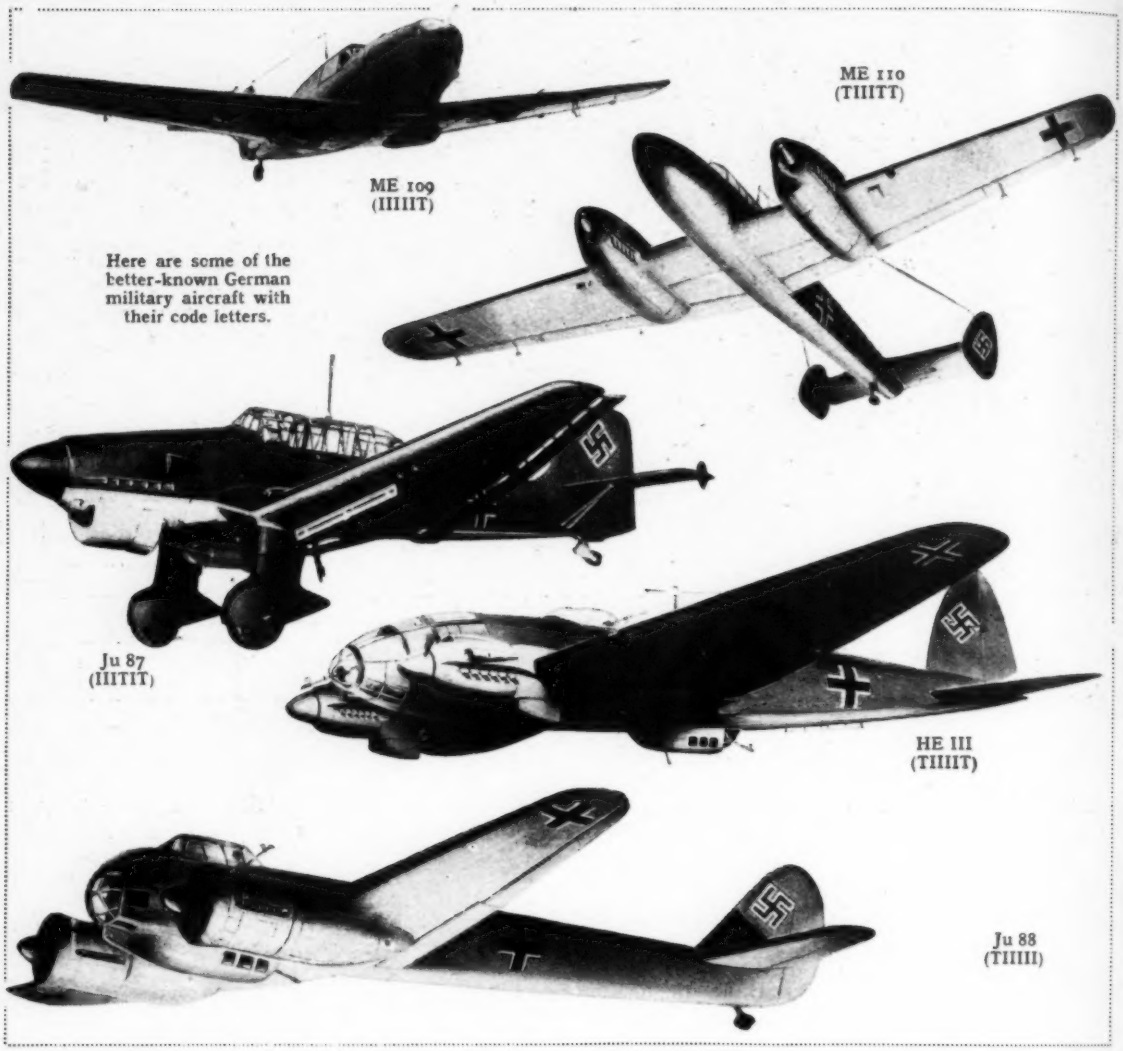
R: fin and rudder (single = I; multiple = T).

C: cowling (radial = I; in-line = T).

Thus appears the master word EFWURC with the six letters in the order of their use.

This is sufficient to describe an aircraft so that it

| Code | | | | | | Types of Aircraft |
|---|---|---|---|---|---|---|
| E | F | W | U | R | C | |
| I | I | I | I | I | T | Messerschmitt Me 109, Heinkel He 112, He 118 and He 170, Arado Ar 79 and Ar 96, Gotha 149. |
| I | I | I | T | I | T | Arado Ar 80, Blohm and Voss Ha 137, Junkers Ju 87, Henschel Hs 125, Klemm Kl 35. |
| I | T | I | I | I | T | Focke-Wulf Fw 159, Dornier Do 18. |
| I | T | I | T | I | I | Heinkel He 114, Henschel Hs 122 and Hs 123. |
| I | T | I | T | I | T | Dornier Do 22, Fieseler Fs 156, Henschel Hs 122, Hs 126 and Hs 121, Focke-Wulf Fw 56. |
| I | T | T | T | I | I | Henschel Hs 123, Arado Ar 95, Bücker Bü 133, Focke-Wulf Fw 44. |
| I | T | T | T | I | T | Arado Ar 68 and Ar 197, Heinkel He 45, He 51, He 60 and He 74, Bücker Bü 131, Gotha 145. |
| I | T | T | T | T | T | Arado Ar 81. |
| T | I | I | I | I | I | Focke-Wulf Condor, Junkers Ju 88. |
| T | I | I | I | I | T | Focke-Wulf Fw 57 and Fw 58, Heinkel He 111 and He 116, Gotha 146, Ago 192, Siebel 104. |
| T | I | I | I | T | T | Henschel Hs 124, Junkers Ju 86 and Ju 89, Me 110. |
| T | I | I | T | I | I | Heinkel He 115, Junkers Ju 52. |
| T | I | I | T | I | T | Dornier Do 23. |
| T | I | I | T | T | I | Blohm and Voss Ha 140. |
| T | I | I | T | T | T | Blohm and Voss Ha 139 and Ha 139b. |
| T | T | I | I | I | T | Dornier Do 26. |
| T | T | I | I | T | I | Dornier Do 24, Do 17 and Do 215. |
| T | T | I | I | T | T | Blohm and Voss Bv 138. |
| T | T | T | T | I | I | Heinkel He 59. |




can be placed in a class containing a very small number of similar aircraft; i.e., ITTTII represents a single-engined, biplane with fixed undercarriage, single-rudder and radial engine cowling. Referring to a chart of German aircraft, this could be a Henschel Hs 123, Arado Ar 95, Bucker Jungmeister or Focke Wulf Fw 44.

With a little practice it should be possible to identify a type from this list within thirty seconds.

Apart from such obvious distinctions as landplanes, floatplanes and flying boats, there are other points which can be utilised in identification such as dihedral of the wings, taper, shape and position of wings.

## *British Air Mail to Egypt*

A STATEMENT recently broadcast to Africa from Zeesen is an example of how this station fabricates its own news. The statement was that, owing to the failure of the English to run an air service to Egypt, the Dutch air lines have been called upon to carry Egyptian air mails. In fact 13 British air services are regularly running to Egypt and back every fortnight. Ten of these are by flying boat and three by landplane. All carry mails between this country and Egypt.

## *Another Lisbon Service*

THE Spaniards sent a Douglas DC3 on the first trial flight of the Madrid-Lisbon service on April 12. The journey occupied 1 hr. 55 min., and regular daily services each way were commenced on April 20. This will link Lisbon, via Madrid, with Barcelona, capital of Cataluña, Rome and Berne. It will also enable German correspondence to get through to meet the American Clippers without the possibility of being searched by British authorities.

Somewhat unnecessarily, one thought, the Spanish aircraft bore the Spanish Nationalist emblem, the badge of the "Falange Española" (Spanish Phalanx). This is entirely the business of the Spaniards, but one sees no reason why a civil machine should flaunt political emblems when the avowed purpose of an airline is, or should be, commercial. There is no point in mixing politics with air travel in this way, and probably not one passenger in a thousand will care about the badge; all passengers want is to be carried to their destinations swiftly, comfortably and efficiently, and the fact that a 'plane has a bunch of arrows painted on it counts for nothing.

## *Posting Times*

IN addition to the despatches by the twice-weekly air-mail service on the route England-India-Malaya-Australia, for which the latest times of posting at the Head Post Office, London, E.C.1, are noon on Wednesdays and Saturdays, air mail for the England-India section of the route is now also despatched on Thursdays, the latest time of posting at the Head Post Office being noon on Thursdays. The latest times of posting at the Head Post Office for Malta, for which the rate is 1s. 3d. per half-ounce (postcards, 7d.), are now midnight on Mondays and Thursdays.

# HERE and THERE

## R.A.F. Training in S. Africa

THE British Government has accepted the offer of the Union of South Africa to make available facilities there for the training of Royal Air Force personnel, who will receive their training with personnel of the Royal South African Air Force. To make all the arrangements with the Union Government regarding technical equipment and finances, a mission, headed by Air Chief Marshal Sir Robert Brooke-Popham, is leaving for South Africa. Sir Robert will also visit Southern Rhodesia in connection with the training scheme which has been initiated there. Other members are: Sir James Stirling Ross, Gp. Capt. A. L. Paxton, Sqn. Ldr. E. F. Porter, and Mr. A. L. M. Cary.

"Flight" photograph

**NO OTHER TIGER. Four members of the staff of the new flying school which the French Government is establishing in Indo-China. From left to right they are: M. Maurice Thoraval (chief pilot), Commandant-Aviateur Louis Castex (organiser of the school), M. Marcel Couratin (chief engineer), and M. Marcel Degand (assistant engineer).**

## Capt. Acland's New Post

HIS many friends at home and abroad will be interested to learn that Capt. P. D. Acland has just taken over the post of Managing Director of Percival Aircraft Ltd., at Luton, Bedfordshire.

## G.A.L. Directors

IN recording the formation of Airtraining (Fai Oaks), Ltd., in our issue of April 11, we inadvertently stated that all the directors of the new company are directors of General Aircraft, Ltd. This is slightly inaccurate in that Mr. S. J. Noel-Brown is secretary, but not a director, of General Aircraft. He is, however, a director of the new company, as stated.

## A Tufnol Loss

NEWS came to this office, just too late to be included in last week's issue, of the death, at the early age of 40, of Mr. E. W. Green, who has for some years been in charge of the development of Tufnol Bearings, Ellison Insulations, Ltd. Mr. Green served with the R.F.C. in Mesopotamia in the last war, and joined the drawing office staff of George Ellison, Ltd., in 1920.

## Tigers in Indo-China

BY arrangement between the Allied Governments, Tiger Moths are to be used for *ab initio* training at the civil flying school which France is establishing in Indo-China. The organisation of the project has been entrusted to Commandant-Aviateur Louis Castex, and the chief flying instructor will be M. Maurice Thoraval. The acceptance tests were conducted in England, and the principal ground engineers have passed through a course at the De Havilland factories. The Tiger Moths have extensive equipment of the R.A.F. type, including blind-flying instruments, navigation lighting, etc.

## Challenge Trophy Holders

THE College of Aeronautical Engineering announces that the holder of the Mollison Trophy for 1940, held each year by the student who has shown the highest standard of general efficiency, is R. B. Wilkinson. This student entered the college with a Wakefield scholarship, has qualified for an Honours diploma, and has passed the Associate Fellowship Examination of the Royal Aeronautical Society. He is now employed in the Engine Experimental Department of the Bristol Aeroplane Company.

The holder for 1940 of the Olley trophy, held each year by the student showing the best results in the practical and commercial side of aeronautical engineering, is K. R. Davies, who has qualified for an Honours diploma and passed the Associate Fellowship examination of the Royal Aeronautical Society, obtaining first place in one subject. He is now on the staff of Rolls-Royce, Ltd., at Derby.

## Do Not Waste Paper

THE Government is to organise special collection schemes for waste paper. Those comparatively few readers of *Flight* who do not habitually retain their copies are asked to save them for the collectors.

## Autogiro Mail Service

SINCE July, 1939, Eastern Air Lines has been operating an air mail service between Camden Airport and the roof of the Philadelphia post office by Kellett autogiro. Five round trips on each of six days per week are done on this short route of six miles.

## Notice to Airmen

NOTICE to Airmen, No. 98, of the Emergency Series, defines prohibited areas in Estonia, while No. 99 prohibits the flight to or over India of all civil aircraft other than those operating regular services or those registered in India, unless special permission is obtained from the Director of Civil Aviation in India.

## Flt.-Lt. H. Bailey

IT is with deep regret that we have to record the death in a flying accident recently of Flt. Lt. H. Bailey, test pilot of Blackburn Aircraft, Ltd. Flt. Lt. Bailey served in the R.N.A.S. in the last war. He afterwards attended Sheffield University, where he obtained an engineering degree. Subsequently he got a short-service commission in the R.A.F., and joined the staff of the Blackburn flying school as instructor in 1933. In 1936, after the death of Capt. A. M. Blake, he was appointed assistant test pilot at Brough.


## FURTHER RATIONING OF PAPER

### A Definite Order to Newsagents is Essential

FURTHER drastic rationing of paper supplies by the Government in consequence of the extension of the war to Scandinavia and partial cessation of imports, means that paper must be conserved in every possible way. One result of this latest restriction is that publishers are compelled to cease supplying journals to newsagents on sale or return. It is thus imperative for readers who wish to avoid disappointment to request a regular copy of *Flight*, as newsagents in future will requisition from the publishers only those copies for which they have received a definite demand.

Thus to ensure a regular copy of this journal, tell your newsagent, without delay, to reserve you a copy each week, or alternatively, for your convenience an order form appears in this issue which you are invited to fill up and hand to your agent. The order can be countermanded at any time in the event of change of address.

Form appears on advertisement page 29.

*R.A.F. Official Photo. Crown Copyright.*

**Fate of a German transport in Norway, taken by the R.A.F. over Kristiansand at 9,000 feet, this photo shows the burning vessel, and in the middle left, another transport at anchor.**

# EQUIP AIR SQUADRONS for the FRIGID ZONES

## *Thinking ahead for winter: Cold-weather operations*

By CAPTAIN NORMAN MACMILLAN, M.C., A.F.C.

THE Empire air training scheme in Canada—a method of training for Empire pilots which the author believes he was the first to advocate—can benefit the Royal Air Force because it will introduce into Britain's Air Service men with experience of real cold-weather conditions on the ground. That is, after next winter's training season.

This introduction of a specialist technique may prove to be an acquisition of particular value during the future development of the present war. It ought to have been acquired before. But Britain has always started her wars with a heavy handicap.

Because of poor publicity the British public is hardly conscious of the work of the Royal Air Force throughout the Empire. The Air Ministry's "hand-out" stories for the Press are naïve; they seldom offer "hard" news.

Indeed, it is well known that the present Chief of the Air Staff objected to publicity, fought shy of reporters, and gave his first (and so far only) interview to the Press, in France, after the war had started.

Well, that is not the way to help the public to give the boys of the R.A F. a hand.

People I meet—in the varied strata which comprise the society (with a small "s." please) to which our oligarchic leaders, with disengaging charm, always refer as a Democracy (large "D")—are hungry for R.A.F. news; real news. But they are being starved by the puerile rationing system of official Air Ministry news (save the word) vendors.

*In this, his fourth article in the series "Air Strategy,' Capt. Macmillan does less than justice to our Air Ministry. Aircraft have been sent to Canada for operational and engine tests.—Ed.*

It isn't, but it ought to be, known in every family that the R.A.F. is responsible for the air defence of every part of the Empire except the territories of the three self-governing Dominions of Australia, Canada and South Africa, who possess air forces of their own. This does not mean that the R.A.F. would not reinforce Dominion air forces in emergency, if help were asked for. And, *per contra*, Dominion air squadrons are now operating with the R.A.F. in Britain and the Near to Middle East.

So anyone joining the R.A.F. may be sent to Norfolk or Nyassaland, Sussex or Singapore, Cromarty or Cyprus, Haddington or Hong Kong, Aden but not Adelaide, Egypt but not Edmonton (except for training), Palestine but not Pretoria—and so on.

Note that (but for training in Canada) all foreign stations of the Air Force are sited in a less temperate climate than that of the United Kingdom. Never a unit of the R.A F. has had to operate with ski-planes.

This just shows how short-sighted has been Air Ministry policy. Why should the Air Ministry, or any other body in the country for that matter, assume that Britain's wars will be fought, as in the past (save for that war which produced the Balaclava helmet), in temperate or torrid zones where wheels, hulls or floats will suffice?

In spite of experience in desert flying in Iraq, Egypt and the Sudan, the R.A.F. went through a bad spell when home-based aeroplanes were crated out to Egypt at the time of the Abyssinian crisis in 1935. Engines were not protected against dust. After eighty hours' running they became compressionless when hot. A pilot who landed and switched off couldn't start until his engine cooled down; and anyone who has waited for an engine to cool off in Egypt, where the weather is warm, knows what has ingrained patience into the Oriental mind. Well, that happened in spite of all the R.A.F.'s experience in desert flying over a period of twenty years. And it happened just because the Air Ministry sent to the desert a batch of home-used aeroplanes fitted with engines which had never been plagued by dust before.

There is nothing unpatriotic in writing this. The R.A.F. was not alone in its experience then. Just after the Abyssinian war ended I was told in Italy that the *Regia Aeronautica* had the same trouble in Eritrea, in spite of its long experience in arid Libya. (Incidentally, the Italians were the first to use an aeroplane in war; that was in the Libyan campaign of 1912 against the Turks.)

### *Portable Oxygen Sets*

But at the time of Abyssinia, in the case of the R.A.F. and the Italian R.A., the troubles didn't matter much. The R.A.F. learned a lesson from which our squadrons now in the desert have profited, while the Italian R.A. was not pitted against an air-equipped enemy anyhow. As neither of the sufferers was anxious to have a go at the other, both got away with their kit-bags-of-troubles; and to-day the R.A.F. is so much the wiser—which is the best thing the Italian air force has done for us since 1918.

History is the record of successes; it ignores the failures—unless they be on a scale so great as to magnify the success of the victors by an inversion of the story (for a writer is sometimes pleased to use a double negative), or on a note so heroic as to cloak a tragic failure in purple velvet.

And as the minutes fly history is writ!

The Air Ministry cannot afford to leave to chance the possibility of another failure like that which was caused by the dismal collection of unsuitable aeroplanes it sent to the Eastern Mediterranean in 1935. So it must prepare for war in any zone—frigid (of which it has no experience) as well as temperate and torrid. Up to the present the R.A.F. has been trained and equipped to operate from the temperate to the torrid zone. Now it must be equipped and trained to operate also from temperate to frigid zones.

It is not enough to say that our aeroplanes function satisfactorily when flying at heights where the temperatures are as severe as those found in frigid zones at sea level. That does not make the machines satisfactory under those conditions on the ground, or on the frozen surface of water turned to ice.

And even at those heights, new perils have had to be countered by the crews' sheer magnificence of physique, perils which ought to have been discounted in advance by the application of foresight and brain power on the ground. Evidently it was never imagined that members of crews might have to leave their posts when flying above the safe limit for flight without oxygen; when they did have to do so they had to disconnect the laid-on oxygen supply and move about without oxygen, with the result that several members of one crew were overcome. This tale was told as though it were a heroic performance. Surely that is just the kind of inversion of which I have just written! The Air Ministry must have heard of the special light-weight mountaineer's oxygen set designed for attacks on Everest, and every long-range, high-flying aeroplane ought to have been fitted with several such sets for the use of the members of the crew having to leave their posts.

### *Problems of Cold*

Reverting to the comparison of flying and ground conditions: at 20,000 feet to 30,000 feet the engines are already giving power to the craft and heat to its occupants; but when equivalent air temperatures are found at ground level there are the problems of keeping the oil at the correct viscosity for starting from cold, of keeping the crews warm before the engines' exhausts flash the steam heaters, of preventing controls from freezing up, and of taking off and landing. To operate aeroplanes with certainty in frigid zones, these and other problems must be not only solved, but the solutions must be tested thoroughly and the crews and ground personnel practised in their routine.

Moreover, an entirely new set of medical requirements for safeguarding the health and efficiency of the non-flying personnel will be found imperative under frigid zone conditions.

Storage of food presents a problem of its own. It is known that tinned food deteriorates rapidly under too cold climatic conditions. The storage of food may therefore demand not refrigeration but recalorification.

Then there is the housing of both the flying and non-flying personnel. How many public works contractors or builders who undertake building for the R.A.F. have practical experience of housing requirements in frigid zones? How much does the Works and Bricks Department of the Air Ministry know about them? If the answer is negative, firms and the department ought to sign on specialists immediately to get on with the job of making proper provision for the housing of personnel, aircraft and transport under sub-Arctic conditions instead of leaving that, too, to the risk of improvisation at the last moment.

Aeroplane and engine constructors also should now be studying the problems they will be required to solve in certain eventualities, bridging the gap until the winter is upon us again by a solid arch of sound constructive work.

Will the airscrews now in use give trouble under such conditions? Airscrew manufacturers must find out, prepare the answers to the problems they envisage or discover.

What are the armament difficulties to be overcome? Get on with that, too, now, before it is too late.

And how many British aircraft manufacturers have any knowledge of skis for aircraft? De Havillands have, but how many others? Mighty few. But component manufacturers might tackle that job as they have tackled the supply of wheeled undercarriages.

This aspect of air war supply is urgent. Weeks fly into months, months to seasons. Summer is no sooner here than autumn makes its unwelcome appearance once more. And autumn signals the beginning of the winter in the northern frigid zone.

The knowledge required must be gleaned quickly and collated rapidly for the benefit of all British air interests. It is all stored in three or four countries—Russia, Fin-

land, Canada and the United States know more about it than any other nation. Our knowledge can be derived from Canada and the United States.

Some men have special knowledge, specialised air exploration knowledge of exceptional value—Rear-Admiral Richard Byrd, Sir Hubert Wilkins, Mr. Lincoln Ellsworth, and the operators of the Canadian winter air transport lines to the Canadian north. Their experience would be invaluable as a guide. Some of the Canadian air transport specialists might be enrolled as expert advisers to the Society of British Aircraft Constructors. The Air Ministry might find the men it needs in the Royal Canadian Air Force.

Anyhow, it is time the matter was in hand, else next winter we shall be flying like Cutty Sark before the witch of fatal circumstance once more.

### *Russian Ice Camps*

It seems strange that of all the nations Russia alone has practised the creation of air encampments on the polar ice. Some time ago, seeking a reason why Russia should be so persistent in this experimental project, I came to the conclusion that it might embrace some idea of trans-oceanic air attack across the frozen surface of the Arctic basin. Not so fantastic is this theory upon investigation. Not only does the Polar basin offer the shortest route to Western North America, but it enables refuelling bases to be established on a moving platform of ice whose drift is always to the west. It might make the only avenue for air attack from Europe against Canada and the United States for some years to come—unless South America were first invaded. It offers a westward air route for the fantastic war organisation of the Totalitarian States instead of the route via Eastern Siberia through Alaska, which would take many more years to organise.

The counter to any such attempt would, of course, be the bombing of the camps on the ice in the effort to break up the camps, and, if possible, trap their occupants in the semi-freezing waters which lie not so far under the Arctic ice sheet. But it might be exceedingly difficult to locate such camps, especially if they were small and numerous rather than extensive in size and few in number.

But my belief in the imminent need for the organisation of an R.A.F. frigid zone school of thought and practice is not based upon the possibility that the Arctic ice sheet might be used as a bridge to reduce the gap between the operational action range of war aircraft and the width of the Atlantic Ocean. It is fixed upon a far more immediate peril that the British air force might find itself handicapped if it were called upon to operate in any of the northern territories of Europe in the winter, or in any part of Europe or Asia where Continental climatic conditions prevail in winter. There must be no risk of the air force being immobilised except when operating from its already classic haunts.

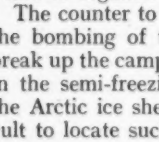
### *Sub-Arctic Mobility*

Recently Lord Beaverbrook wrote in the *Sunday Express* that the charge that Britain had failed to send air squadrons to the aid of Poland and Finland was a false charge. He properly pointed out that all we promised Poland was to go to war with Germany if Germany attacked Poland. But then he said that in any case Poland and Finland did not possess air bases from which R.A.F. squadrons could operate.

Now I have been on Finnish military aerodromes in mid-winter, when it was perishingly cold. And I quite agree that the R.A.F. would have found it difficult to operate from them. But, in my opinion, the main reason for the difficulty would have been not what Lord Beaverbrook suggests but the lack of knowledge and preparation in the R.A.F. for operating under sub-Arctic conditions. It's just as well we didn't send squadrons there to demonstrate another flop like the flop of 1935. And Poland in winter (if the war had lasted so long) is not much better than Finland.

The truth is that the Royal Air Force has no mobile squadrons for operation in sub-Arctic conditions. It never has had any. It has had no call for any before this war. But it may need plenty before it is over.

Clearly it is time for the Air Ministry and the British aircraft industry to set out to conquer a (to them) new technique and so enable a mobile part of the Royal Air Force to possess the men, the machines and all the appurtenances that go with them to operate successfully in the coldest part of the frigid zone through the long winter night. It is a big problem. We have the summer in which to find the solution.



## AIR YOUR KNOWLEDGE

1 Is balsa wood used in the construction of any large aircraft ?

2 What is the N.A.C.A.?

3 Has the French Air Force any imported fighters apart from the Curtiss H75-C1 ?

4 Who was the first woman to fly the Pacific ?

5 What is the highest revving engine used in R.A.F. bombers ?

6 What was the armament of the S.E.5 ?

7 What German manufacturing concern standardises on tubular-spar wings ?

8 How many V.C.s were awarded in the Great War for air gallantry ?

9 What is the meaning of the term "wash-in" ?

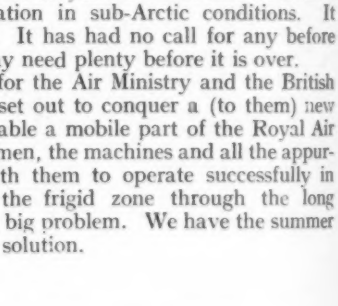
10 What make of parachute is standardised in the R.A.F.?

11 What is an aerodyne ?

12 What was the original name of the Hawker Fury ?

**The answers to these questions will be found on page 390**

*To what aircraft does this tail belong?*



# SERVICE AVIATION

*Royal Air Force—* *—Official Announcements*

## *Honorary Chaplain to the King*

THE Air Ministry announces the appointment of the Rev. Maurice Henry Edwards, O.B.E., B.A., Chaplain-in-Chief, Royal Air Force, as an Honorary Chaplain to His Majesty the King in succession to the Rev. James Rowland Walkey, C.B.E., M.A., who relinquished the appointment on his retirement on April 10, 1940.

## *Awards*

THE King has been graciously pleased to approve of the following awards for gallantry and devotion to duty in the execution of air operations:—

DISTINGUISHED FLYING CROSS

CAHILL, A.F.C., WING COMMANDER CHARLES HOWARD.

Wing Commander Cahill, who is 43 years, was born at Bristol and was educated in Paris and at the Technical School, Belfast. He served as a private in the R.A.M.C. between 1914 and 1916 and then as gunner in the R.F.A. and cadet in the R.F.C. in 1917, and at the end of the war was a Lieutenant in the R.A.F. Continuing in the R.A.F. after the war, he was promoted Wing Commander in 1938 and served in Iraq and the Mediterranean. He was awarded the A.F.C. as a New Year honour in 1933.

PEACOCK, SQUADRON LEADER GEORGE ERNEST.

When leading a formation of aircraft on a raid on enemy warships at Bergen, Sqn. Ldr. Peacock displayed remarkable courage and determination. After the original attack by his formation he returned alone and repeated his run over the target in the face of heavy anti-aircraft fire. When on the return flight to his base he again turned back to attack a hostile flying boat which was shot down into the sea.

Sqn. Ldr. Peacock was born in 1913, at Spennymoor, Co. Durham. He entered the Royal Air Force College, Cranwell, in September, 1931, and was granted a permanent commission as Pilot Officer in General Duties Branch, R.A.F., in July, 1933. After service in the Mediterranean was promoted Squadron Leader in August, 1939.

PHILLIPS, FLIGHT LIEUTENANT FRANK.

Flt. Lt. Phillips and Cpl. Lillie, awarded the Distinguished Flying Medal, were respectively captain and rear gunner of an R.A.F. aircraft that was attacked by six Junkers 88 aircraft when on convoy escort patrol early this month. By his skilful handling of the aircraft, Flt. Lt. Phillips avoided the first attack by machine gun fire from two enemy aircraft and so manœuvred that Cpl. Lillie, by well-directed fire which, in the face of oncoming attacks, he withheld until the enemy were within 100 yards, was able to bring down one of the enemy aircraft into the sea in flames.

Born in Cornwall, in 1915, Flt. Lt. Phillips became a pupil pilot in the R.A.F. in 1936 and was granted a short service commission the same year, being graded Pilot Officer in 1937. He was promoted Flying Officer in 1937 and Acting Flight Lieutenant last July. He was mentioned in despatches in February.

RYDER, A./FLIGHT LIEUTENANT EDGAR NORMAN.

Earlier this month this officer took off alone in bad visibility and low cloud to investigate an enemy raid at sea. He sighted an enemy aircraft and, observing that its port engine was out of action, he promptly attacked the starboard engine. After he had disabled it with one burst of fire, the aircraft fell into the sea.

Flt. Lt. Ryder later found that his own aircraft was losing power and was forced to come down on the sea. His aircraft sank immediately. When at a considerable depth he managed, with great difficulty, to extricate himself from the cockpit and struggle to the surface. He was picked up by a trawler. His accurate flying made the interception a success, and his coolness and courage materially contributed to his own rescue and the collection of much valuable information.

Flt. Lt. Ryder, who was born in India in 1914, was given a short service commission in the R.A.F. in 1936. He was promoted Flying Officer in February, 1939, and Acting Flight Lieutenant five months later.

FRENCH, FLYING OFFICER DEREK JACK.

F/O. French successfully attacked, in the face of intense anti-aircraft fire, a German cruiser in the Bergen roadstead, enabling his navigator and bomb-aimer, P/O. Mulloy, to secure a direct hit on the cruiser. This operation necessitated more than 1,000 miles flying over the sea.

Educated in Melbourne he became an Air Cadet in the Royal Australian Air Force in 1937, and in 1938 was given a short service commission in the Royal Air Force.

MCLAREN, FLYING OFFICER ANDREW HOOD.

Flying Officer McLaren was born in 1918 at Montreal and was educated at Daniel Stewarts College, Edinburgh, and later studied engineering at Dundee Technical College. He was granted a commission in the R.A.F. in 1936.

MULLOY, PILOT OFFICER WILLIAM ARTHUR COOTE.

P/O. Mulloy was born in London in 1919 and received a short service commission in the Royal Air Force in 1938.

DISTINGUISHED FLYING MEDAL

BANNISTER, FLIGHT SERGEANT BERNARD MAURICE.

Flight Sergeant Bannister, who is aged 28, joined the R.A.F. as an aircraft apprentice fitter in 1928. He reached his present rank in January last year.

MAUDSLEY, SERGEANT ARTHUR TERENCE.

Sergeant Maudsley, who was born at Morecambe in 1914, was a gardener before joining the R.A.F. in 1931. His home is now at Caton, Lancashire, and he reached his present rank in 1938.

REEN, SERGEANT ANTHONY PAUL.

Sergeant Reen, who is aged 24, was employed in a garage before enlisting in the Royal Air Force in 1935. He reached his present rank in 1939. His home is at Leigh-on-Sea, Essex.

One of the recipients of these decorations is described as a very good and able pilot, extremely energetic, and with very sound judgment. Another carried out a reconnaissance flight to the Norwegian coast which entailed returning to a strange aerodrome in darkness. He flew blind from Norway. On another occasion when his aircraft crashed his prompt action saved many lives from the danger of bursting bombs.

LILLIE, CORPORAL WILLIAM GRAY.

The exploit for which Corporal Lillie gained this distinction as a rear gunner is mentioned opposite in connection with Flt. Lt. Phillips, who was his pilot. He joined the R.A.F. in 1937.

## *London Gazette*

### *Royal Air Force*

The Reverend M. H. Edwards, O.B.E., B.A., Chaplain-in-Chief, Royal Air Force, is appointed an Honorary Chaplain to the King (April 10).

*General Duties Branch.*

The following are granted commissions for the duration of hostilities as Pilot Officers on probation (Jan. 17):—Sgts W. H. Hill, J. Mills, J. Wright; Cpl. F. S. Jackson; A/C. 1st Class G. N. Hutchence.

The following are granted short service commissions as Acting Pilot Officers on probation for four years on the active list on the dates stated:—(March 6) A. S. Boak; (March 23) D. R. Bagnall, R. W. G. Beley, A. E. Berry, R. D. Boyd, W. B. Christophers, J. Comar, R. H. Crush, J. Cutmore, D. G. Dickie, W. M. Douglas, J. L. W. Ellacombe, R. E. Fawcett, C. A. G. Ferguson, F. K. Gill, R. J. Hannan, G. H. F. Inniss, J. T. Johnston, H. G. Keartland, R. M. A. Lakin, H. L. Marshall, H. H. J. Miller, J. D. Reardon, H. W. Reilley, J. B. Robertson, J. H. J. Sauvage, N. E. Sharp, W. J. Sipprell, I. S. Smith, N. A. Svenson, C. F. Tibbitts, G. S. Williams, A. R. Zatonski.

The following Acting Pilot Officers on probation are confirmed in their appointments and graded as Pilot Officers on the dates stated:—(Nov. 6, 1939) J. R. Whelan, J. A. Sherry; (March 6) O. R. Pilsworth; (March 13) E. H. Petley; (March 18) R. D. May.

The following Acting Pilot Officers on probation are graded as Pilot Officers on probation on the dates stated:—(Feb. 10) A. C. Lawson, G. J. Le Mar; (Feb. 18) D. McIntosh, J. V. Eason, P. J. Gordon-Hall, R. A. Plumb; (Feb. 28) C. M. Stavert; (March 1) R. A. G. Paramore, M. S. Blyth; (March 4) F. J. Aldridge, D. W. Peck; (March 9) A. J. S. Buller; (March 10) R. C. W. Barnes.

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—(Jan. 16) F. J. Kelly; (March 16) H. W. A. Sheahan; (March 21) A. L. Pitfield; (April 6) R. G. Ker-Ramsay; (April 7) E. G. Jones, W. M. Penman, J. B. Burnett, R. G. D. Nathan, P. A. Gilchrist.

The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—(Nov. 5, 1939) J. R. Taylor; (March 23) R. D. Max; (March 27) P. H. Knowles, T. James, A. Brown, G. C. Banning Lower; (April 10) Hon. R. A. G. Baird.

The following relinquish the acting rank of Flight Lieutenant on the dates stated:—F/Os (Oct. 6, 1939) B. R. O'B. Hoare; (Dec. 18, 1939) M. N. McF. Kennedy; (Jan. 21) P. W. Dawson; (Jan. 29) R. W. Gautrey, V. E. Marshall (since promoted); (Jan. 31) J. G. Cave; (Feb. 27) R. G. Ker-Ramsey; (Feb. 29) R. L. Lorimer; (March 26) S. C. Pendred. P/Os (Nov. 21, 1939) T. O. Prickett; (Jan. 15) E. P. Henley.

The following Flying Officers relinquish their temporary commissions on return to army duty on the dates stated:—(March 13) E. R. E. Dayrell (Lt., R.A.); (March 27) R. A. Fyffe (Lt. Rifle Bde.).

The short service commissions of the following Acting Pilot Officers on probation are terminated on cessation of duty on the dates stated:—(April 8) C. Wright; (April 12) R. S. Currie.

Acting P/O. J. Smith is dismissed the Service by sentence of General Court Martial (March 29); P/O. R. J. MacDonogh is cashiered by sentence of General Court Martial (March 29).

*Equipment Branch.*

Acting Pilot Officer on probation N. C. Ogilvie is graded as Pilot Officer on probation (March 17).

The following temporary promotions are made with effect from March 11:—

Wing Cdrs. to be Group Capts.:—M. J. James, M.B.E., F. N. Trinder, K. D. G. Collier, T. G. Bowler.

Sqn. Ldrs. to be Wing Cdrs.:—C. Hanson-Abbott, M.B.E., S. R. L. Poole, J. R. Brown, M. H. Jenks, F. R. Lines, W. F. Langdon, L. L. Bray, F. E. R. Dixon, M.C., F. W. Felgate, G. H. Doveton, M. F. Tomkins, C. S. Whellock, P. P. S. Rickard, A. G. Stratford-Tuke, J. E. R. Sowman.

Flt. Lts. to be Sqn. Ldrs.:—G. J. Gaynor, W. H. Dyson, E. G. Moore, G. G. N. Marshall, M.B.E., G. R. Thwaite, H. E. Bethell, P. G. Buller, B. H. Alder, C. H. V. Harding, L. Mitchell, C. E. Lindsell, G. Jones, F. Gale, C. J. Salmon, K. T. Nicklin, M. C. R. White, W. J. Stutchbury.

*Medical Branch.*

Warrant Officer L. C. F. Twelves is granted a commission for the duration of hostilities as Qrmr. and Flying Officer on probation (Dec. 19, 1939).

## Service Aviation

*Chaplains Branch.*

The Rev. M. H. Edwards, O.B.E., B.A., is appointed Chaplain-in-Chief in succession to the Rev. J. R. Walkey, C.B.E., M.A., and is granted the relative rank of Air Commodore (April 10); the Rev. J. R. Walkey, C.B.E., M.A., is placed on the retired list (April 10).

*Errata.*

In *Gazette* of July 11, 1939, for G. A. Hampton read T. A. Hampton; in *Gazette* of Nov. 21, 1939, notification concerning Warrant Officer P. F. Overton, for Oct. 28, 1939, read Sept. 23, 1939; in *Gazette* of Jan. 16, notification concerning Warrant Officer S. F. Browne, for Dec. 18, 1939, read Dec. 7, 1939; in *Gazette* of April 2, for G. C. N. Close, E.C.M., read G. C. N. Close, E.G.M.

## Royal Air Force Reserve

RESERVE OF AIR FORCE OFFICERS.

*General Duties Branch.*

The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—(Sept. 30, 1939), J. Blackburn, A. D. Frank, C. W. Furse; (March 23) R. Hawkins, J. A. Meads.

Sqn. Ldr. R. S. G. C. Lucy, A.F.C. (Squadron Ldr., R.A.F., Ret.) relinquishes his commission in class CC on cessation of duty (Feb. 17); Flt. Lt. P. H. D. Blackman relinquishes his commission on cessation of duty (Nov. 5, 1939); Flt. Lt. M. E. B. P. Storrie relinquishes his hon. commission on cessation of duty (April 1).

## Royal Air Force Volunteer Reserve

*General Duties Branch.*

The following are granted commissions for the duration of hostilities in the ranks and on the dates stated:—Pilot Officers on probation.—(March 3) J. R. M. Sales; (March 4) J. R. Moore; (March 10) L.A/C. K. D. Burton, A. W. V. Green, A. M. McEwan, R. M. M. Biden, E. J. Clelland, K. D. Faulkner, E. G. Leathem, J. Morris; (March 20) J. Stansell. Acting Pilot Officers on probation.—(Feb. 13) J. H. Wilson; (March 9) R. M. Broadhead; (March 23) W. M. L. Fiske.

P/O. T. S. Tull is promoted to the rank of Flying Officer (July 23, 1938); the notification in *Gazette* of March 19, concerning Sgt. D. E. C. Myland and M. J. D. O'Leary is cancelled.

*Administrative and Special Duties Branch.*

The following are granted commissions for the duration of hostilities as Pilot Officers on probation with effect from the dates stated and with seniority of Feb. 1:—(Feb. 7) Cpl. C. H. R. Hulbert; (Feb. 17) Acting Flt. Sgt. H. J. Ball, Acting Sgt. S. C. Barrell, Acting Cpl. C. J. Hinnell, Acting Cpl. R. F. Sandeman, L.A/C. M. C. Rawlence, A/C. 1st Class M. E. Cauvin, A/C. 1st Class D. E. Smith, A/C. 2nd Class G. N. Joye, A/C. 2nd Class O. S. Todd; (Feb. 19) Sgt. H. W. G. L. England, A/C. 2nd Class D. N. Lowe; (Feb. 21) Acting Cpl. C. d'E. Trevelyan; (Feb. 22) A/C. 1st Class S. Broadhead, A/C. 2nd Class P. E. Frost; (Feb. 23) Acting Cpl. J. A. Christie; (Feb. 25) Acting Cpl. A. M. Puckle, Tempy. Cpl. L. E. A. Peachey, L.A/C. H. M. Collinson, L.A/C. R. C. B. Thackeray; (Feb. 26) Acting Flt. Sgt. G. N. Holtby, Acting Sgt. E. J. C. Smither, Acting Sgt. L. B. Stonebridge, Cpl. C. B. Beardsley, Acting Cpl. J. M. M. Bloor, Acting Cpl. J. D. Chomley, Acting Cpl. J. A. Forgie, Acting Cpl. G. J. Haynes, Acting Cpl. H. D. Morton, A/C. 2nd Class B. J. Dodridge, A/C. 2nd Class J. F. Taylor; (Feb. 28) Acting Cpl. R. T. Sutton, A/C. 2nd Class S. H. Claydon; (Feb. 29) Acting Cpl. J. Raven; (March 1) L.A/C. R. J. V. Falkner, M.C., A/C. 1st Class R. R. Piggott A/C. 1st Class A. G. Shepard.

The following are granted commissions for the duration of hostilities as Pilot Officers on probation with effect from the dates stated and seniority of Feb. 15:—(March 1) Cpl. W. N. C. H. Pitts, Cpl. R. A. Rogers; (March 4) Acting Cpl. G. P. Pemberton, A/C. 2nd Class F. C. Preston; (March 6) A/C. 2nd Class F. W. Wentworth-Shields; (March 7) Cpl. A. J. Warren; (March 8) A/C. 1st Class B. M. Davison; (March 10) Cpl. S. P. Cough, Cpl. E. W. Tarplett, A/C. 1st Class S. C. Smallman; (March 11) Sgt. C. P. Fendick, Cpl. C. R. M. Clarke, Cpl. R. R. Smith, L.A/C. E. H. Wilkinson, A/C. 2nd Class G. W. Hodgson; (March 13) Cpl. N. S. Durant, A/C. 2nd Class G. McM. Brown; (March 14) L.A/C. E. P. Whitehorn; (March 18) Cpl. C. Metcalf, Cpl. T. W. Williams, Cpl. H. D. Wyatt.

The following are granted commissions for the duration of hostilities as Pilot Officers on probation on the dates stated:—(Sept. 9, 1939) R. G. Goodfellow; (Dec. 11, 1939) L. D. Stuart; (Feb. 23) T. B. Skinner; (Feb. 26) M. C. M. Peters; (March 8) L. M. Page; (March 9) R. F. Pearson, M.C.; (March 11) S. B. Bailey; (March 12) R. B. Rawson; (March 14) T. B. Child, G. Davis, R. E. Le Sueur; (March 16) C. G. P. Kirk; (March 17) F. C. Andrews, W. J. Daniel; (March 18) A. J. Allen, Sir Felix J. M. Brunner, R. P. Bufton, C. B. Burdock, C. C. Castle, A. H. G. Craske, H. R. Gray, R. Greenough, H. O. Gregory, W. J. Guppy, A. Moore, H. C. F. Pelham-Clinton, J. R. A. Savidge, V. A. Short, C. R. Tunks, J. H. Weaver, W. P. Wilson; (March 19) R. P. Beamish; (March 20) D. S. Gales, J. T. Hunter; (March 21) M. J. P. Lacy; (March 23) H. N. Aldridge, W. B. Sinclair; (March 25) W. F. Booth, D. F. Burt, M. Imeretinsky, R. H. Thomas, J. C. De H. Vaizey, H. N. Witting; (March 26) E. H. Dinsley, F. Farmer, C. Y. McDonald, A.F.C., M. McGougan, L. W. Waddell, B. H. Wood; (March 27) W. G. Hicks, M. H. B. Jones, H. F. Nicholls, D.F.C., F. J. W. Williams; (March 28) P. N. L. Nicholson, E. S. Virpsha; (March 29) S. Broadbent; (March 30) J. C. Hardman, E. A. R. Landon; (March 31) F. W. Jelpke, A. H. Pooley; (April 1) C. G. Davenport, T. F. Owen, J. C. Thompson, J. Thompson; (April 2) C. T. Maclaren, L. M. Peet.

The following Pilot Officers on probation are confirmed in their appointments and promoted to the rank of Flying Officer on the dates stated:—(Sept. 1, 1939) R. W. Nicholson; (Sept. 9, 1939) C. H. G. Soper; (Feb. 9) J. F. Arnold.

The following resign their commissions on the dates stated:—(April 8) F/O. R. L. Farley; (April 1) Pilot Officer on probation J. J. Lister.

The commissions of the following Pilot Officers on probation are terminated on cessation of duty on the dates stated:—(March 10) A. G. Rimmer; (April 12) H. H. Michael.

The notification in *Gazette* of April 11, 1939, concerning H. R. Davies is cancelled.

*Equipment Branch.*

Payr. Lt. A. J. T. Hutley (R.N., Ret.) is granted a commission as Flight Lieutenant with effect from Sept. 1, 1939, and with seniority of May 10, 1939.

The following are granted commissions for the duration of hostilities as Pilot Officers on probation on the dates stated:—(Sept. 13, 1939) Capt. H. N. Reynolds, M.C.; (Nov. 3, 1939) W. J. Brett.

The following Pilot Officers are promoted to the rank of Flying Officer:—(March 6) A. Williams, F. Williamson, C. E. Wratten.

*Medical Branch.*

The following are granted commissions for the duration of hostilities in the ranks and on the dates stated:—Flight Lieutenants (March 19) E. D. E. E. O'Brien, M.B., B.S., D.O.M.S.; (March 26) J. A. Lennox, M.D., B.S., R. A. Wilson, M.D., Ch.B., D.P.H. Flying Officers (Feb. 27) J. F. Buckmaster, M.R.C.S., L.R.C.P.; (March 19) L. W. Aldridge, M.B., Ch.B., G. P. Barclay, M.B., Ch.B., E. R. Brown, L.M.S.S.A.; E. I. Davis, M.R.C.S., L.R.C.P., J. Graham, M.R.C.S., L.R.C.P., A. M. Gunn, M.B., Ch.B., J. M. MacCormack, M.B., Ch.B., J. O'Brien, L.R.C.P. and S., J. Watson, M.B., B.Chir., M.R.C.S., L.R.C.P.; (March 26) H. J. Baigel, M.B., Ch.B., F.R.C.S. (E), D.P.H., R. S. Castle, M.B., B.Ch., M.R.C.S., L.R.C.P., A. L. Collins, M.B., B.S., M.R.C.S., L.R.C.P., R. Cuddeford, M.B., Ch.B., R. F. H. McElligott, M.B., B.Ch., G. T. B. Mackinnell-Childs, B. Chir., M.R.C.S., L.R.C.P., G. Macnaughtan, M.B., Ch.B., G. Oppenheimer, M.B., B.Ch., M.R.C.S., L.R.C.P., E. G. Patchett, L.R.C.P. and S., L.R.F.P.S., A. J. B. Phillips, M.B., B.S., G. Pollock, M.D., Ch.B., F.R.F.P.S., A. E. Ross Chalmers, L.R.C.P. and S., L.R.F.P.S., G. Shneerson, M.B., B.S., M.R.C.S., L.R.C.P., H. C. Thomas, M.B., B.S., M.R.C.S., L.R.C.P., P. Wilson, M.R.C.S., L.R.C.P., D.O.M.S., N. A. F. Young, M.R.C.S., L.R.C.P.

Flying Officer W. W. Mackinlay, M.B., Ch.B., resigns his commission (April 8).

*Chaplains Branch.*

The following are granted commissions for the duration of hostilities with the relative rank of Squadron Leader on the dates stated:—(March 20) The Rev. I. R. Henderson; (April 2) The Rev. R. F. W. Durrant, B.A.

*Legal Branch.*

W. A. Pritchard, M.A., is granted a commission for the duration of hostilities as Flight Lieutenant (April 3).

*Erratum.*

In *Gazette* of Dec. 19, 1939, notification concerning A. B. W. Greenhough, for Acting Pilot Officer on probation read Pilot Officer on probation.

## Auxiliary Air Force

*General Duties Branch.*

The following Acting Pilot Officers on probation are confirmed in their appointments and graded as Pilot Officers on the dates stated:—(Sept. 1, 1939) W. F. Scott, E. H. Stewart; (Sept. 8, 1939) A. R. Gillespie.

A.P/O. E. W. Latham relinquishes his commission on account of ill-health (April 12).

## Women's Auxiliary Air Force

Aircraftwoman 2nd Class Miss M. V. M. Thompson is appointed in the rank of Assistant Section Officer (April 7).

## Casualties

THE Air Ministry regrets to announce the following casualties on various dates:—

KILLED IN ACTION.—P/O. K. Brooke-Taylor (41251); Sgt. A. McNicol (583207); P/O. W. Roberts (40319).

PREVIOUSLY REPORTED "MISSING," NOW PRESUMED "KILLED IN ACTION."—A./Flt. Lt. J. W. Allsop (39452); A/C.1 J. Bateson (533911); A/C.1 J. R. Bell (550003); L.A/C. F. Ellison (526415); P/O. A. G. Salmon (40321); F/O. D. A. Strachan (39580).

WOUNDED OR INJURED IN ACTION.—F/O. G. F. Brotchie (39708); Cpl. E. Hodgson (520046); Flt. Sgt. G. A. Powell (508952); P/O. A. T. Sword-Daniels (77127).

"MISSING," BELIEVED "KILLED IN ACTION."—A/C.2 H. G. Ablett (626935); L.A/C. D. Armstrong (543847); P/O. F. E. Barber (36223); L.A/C. M. F. Bedford (550969); Sgt. F. F. Bestick (580598); Sgt. H. Bratton (580637); P/O. G. W. Brundish (77036); P/O. P. E. Bull (76004); Sgt. D. W. A. Chambers (740907); P/O. J. P. Chester-Master (76006); A/C.2 G. Flynn (628401); P/O. R. A. Gayford (40295); Sgt. G. W. J. Juby (514904); L.A/C. S. Kershaw (611349); Sgt. W. L. Macdonald (580877); F/O. D. C. Maybury (33325); Sgt. R. J. Moore (522730); A/C.1 J. Moss (629737); Sgt. M. F. Murphy (580735); Sgt. W. F. Nicol (740335); A./Sqn. Ldr. M. Nolan (37114); Sgt. A. S. Pearce (580805); A/C.2 R. C. Peel (629076); P/O. D. A. Rankin (36180); A/C.1 D. W. Sharpe (541437); F/O. D. H. Wardlaw (40157); L.A/C. L. A. Westcott (545537); P/O. E. A. Wickenkamp (41088); Sgt. G. M. Wild (580291).

MISSING.—Sgt. A. G. R. Allan (562405); Sgt. J. A. L. Barter (751471); Sgt. F. W. Batchelor (563051); F/O. L. G. Bowler (39431); P/O. J. B. Bull (40599); Sgt. J. C. Carpenter (745604); A/C.1 P. W. S. Chalmers (619757); L.A/C. R. Coalter (616989); A./Flt. Lt. R. J. Cosgrove (39456); A./Cpl. J. Doran (535553); A./Sgt. G. W. Everatt (580714); A/C.2 G. Eveson (635904); A./Cpl. G. Fawcett (623895); A/C.1 O. F. George (610031); A/C.2 H. Gillott (623761); Cpl. O. Haire (507057); Sgt. R. Hawes (565704); P/O. C. R. Hebeler (40300); Sgt. J. R. Ibbotson (580861); A./Flt. Lt. P. W. H. Kite (40231); P/O. A. F. Lemaistre (41033); A/C.1 G. H. Maile (543456); F/O. A. H. McLaren, D.F.C. (39019); A/C.1 R. L. Millar (569861); L.A/C. J. A. Milne (610765); L.A/C. F. A. Morrison (522580); Sgt. W. S. Nevinson (580404); P/O. G. L. Norman (70871); Sgt. W. C. Parker (580804); P/O. A. D. Pilcher (40848); F/O. J. D. V. Porter (39619); F/O. G. E. Saddington (37945); A/C.2 F. Tootle (625665); L.A/C. D. W. B. Upham (562805); Sgt. L. C. Wakeling (740420); Sgt. H. J. Weller (562377); Cpl. M. Wilson (522495); P/O. G. J. D. Yorke (36185).

KILLED ON ACTIVE SERVICE.—P/O. K. R. B. Ainsworth (42177); Sgt. J. R. Branton (564122); L.A/C. M. H. Costello (546959); P/O. J. M. Davies (40094); L.A/C. P. K. Davies (540572); P/O. A. M. Edgar (41270); Cpl. A. E. Jones (531577); L.A/C. R. W. E. Jordan (539923); Sgt. J. A. Lewis (563644); L.A/C. A. R. Martin (528493); F/O. L. A. McSherry (39640); Sgt. H. E. Pettit (580495); P/O. G. I. Thomson (70878).

WOUNDED OR INJURED ON ACTIVE SERVICE.—A/C.2 A. R. H. Chiverrell (907280); Sgt. L. W. Creasey (515958); P/O. R. M. C. N. de Lestang (40608); Sgt. J. B. Griffith (581176); P/O. E. R. Hale (42219).

DIED ON ACTIVE SERVICE.—A./Flt. Lt. W. J. Brett (18132); F/O. D. A. Crane (72170); A/C.1 R. I. Geddes (548203); A./Sgt. L. A. Green (581440); A/C.2 T. J. Hotten (570190); Flt. Sgt. J. McArthur (1009); A/C.2 H. J. Taylor (645484); L.A/C. E. A. Towse (612430).

PREVIOUSLY REPORTED "MISSING," NOW REPORTED "SAFE."—F/O. C. H. Boxall (37903); L.A/C. W. W. Martin (536352); Sgt. L. Podger (580525).

PREVIOUSLY REPORTED "KILLED ON ACTIVE SERVICE," NOW REPORTED "KILLED IN ACTION."—P/O. H. Dodgson (41525).

The following casualties were omitted from earlier communiques:—

WOUNDED OR INJURED IN ACTION.—A/C.2 A. Bates (616288); A/C.2 R. K. Charles (552137); A/C.1 E. W. Gimson (541685); P/O. M. A. Poulton (36148); A./Flt. Lt. A. E. Hyde-Parker (37071); L.A/C. E. Jones (523574).

WOUNDED OR INJURED ON ACTIVE SERVICE.—A.P/O. N. E. Berrington-Pickett (42388); Sgt. A. F. Butterick (741431); Flt. Cadet C. T. Davis (581702); P/O. A. C. Dier (40090); A/C.1 R. P. A. Dougan (537309); Sgt. E. Evans (523522); A/C.1 F. W. P. Hedley (528077); P/O. G. C. Hunter (60474); F/O. D. E. Milson (28198); Sgt. M. O'Donavan (604142); L.A./C. H. Rocknean (520821); P/O. N. W. Walders (41758); P/O. C. P. L. Wilcock (70882).

# COMMERCIAL AVIATION

**OUR END OF THE ATLANTIC SERVICE: Early next month will start a regular British service between London and Lisbon, linking there with the Pan American Atlantic. Recently an Albatross was flown to Lisbon experimentally, where it is seen (above) at Sintra aerodrome with visitors and hosts. In the centre of the group is our Ambassador to Lisbon, Sir Walford Selby.**

## SELLING AIR TRANSPORT

### *"A. Viator" On Saying It with Flowers, and with a Silver Spoon Across One's Tonsils*

LAST week I remarked that the rather wild stories of K.L.M. pilots making aerial dashes from Oslo to Sweden were not altogether confirmed. My reasons for doubting these yarns about thrilling night flights from military occupied territories were several. No neutral pilot with any sense will take a commercial air liner into a potential air battle area, any more than a merchant skipper will steam through the midst of a naval engagement.

Air liner skippers are not the desperate swashbucklers some newspapers make them out to be. They are cautious, peaceful folk, whose only object is to avoid trouble and to bring their ship, passengers and cargo, safely to port.

It is always madness for the commander of a comparatively slow airliner to make any sort of spectacular dash without the permission of whatever belligerent happens to be in control at the moment, and Commander Van Dyk, of K.L.M., himself underlined this fact when he asserted that at Oslo airport he saw the wreckage of two Norwegian planes which had been shot down when attempting to escape. "The wreckage of their machines," he said, "was a warning of what would happen if I tried to take off."

So all the fine confused verbiage some newspapers handed out amounted to nothing at all, except a fit of mendacious hysterics. Poor Van Dyk, who is definitely one of the "lean kine," was referred to as the 15-stone Dutch skipper, and also as the man known throughout Europe as the Captain Kettle of the Air.

That is the utmost idiocy for Van Dyk is clean-shaven, and the only man who has ever had that title conferred on him is Capt. O. P. Jones, of Imperial Airways, who has both torpedo beard and the cigar of Cutcliffe-Hyne's truculent little hero.

Capt. O. P. Jones, by the way, with Capts. L. V. Messenger and J. T. Percy, is the pilot who commenced the Airways Corporation England-Portugal service with D. H. Frobisher machines which, rather surprisingly, A. C. seems to have retained, instead of losing them to O. C. Teapot Lids consigned to our gallant troops in France. This service will shortly be properly on its feet, by the way, and carrying passengers, freight and, above all, mails, as a regular service. On the K.L.M. Amsterdam-Portugal line passengers are to be carried, and this line is run by Commander Parmentier and other K.L.M. veterans.

#### *Reception at Lisbon*

I hear that the reception of the first K.L.M. plane at Lisbon was quite an impressive one. As usual K.L.M. said it with flowers, in the form of some boxes of beautiful blooms gathered in Holland the same morning, which were handed to the wife of the President of the Portuguese Republic. That is a proper K.L.M. habit and I remember a number of occasions on which box after box of flowers consigned to local notables and to local hospitals have been unloaded at North of England airports, Speke, Ringway, Hull, Doncaster, etc., when air lines from Holland were opened up to those places. It is not only a matter of pleasant courtesy, but one of showmanship combined with salesmanship.

My criticism of civil aviation, as understood in some companies, is that it is too high hat—all pin-stripe pants,

red carnations, Anthony Eden hats, umbrellas and hangover cordials in the Savoy bar. Civil aviation is not, and should not ape, the Civil Service, and there should be no one in the shop who is too proud to get behind the counter and sell a man a super seat in a super tram with wings, or to quote some possibly illiterate tradesman for cargo space to accommodate half a ton of pig's bristles.

Aviation people, like leather curriers or curriers of prawns in tins, are simply tradesmen, but in our business you must be a bit of a showman, too, and not ashamed to do a spot of window dressing.

There's a yarn of one of these pink carnation lads trying to sell cargo space round Covent Garden, Smithfield or Billingsgate way; a boy born with a silver spoon in his mouth which had somehow lodged athwart his tonsils and affected his accent. The only reply he got from the ruddy-faced, and I must confess, ruddy-minded fruit or fish merchant, was "Lah de—blue pencil dah—Yah!" which is not good for business.

Another thing which happened last week to cheer up those who predict the complete decline and fall of all civil aviation, was the appearance in this country of a DC3 belonging to the Irish company Aer Lingus Teorana. It came from Holland, and had been purchased by the Irish company for work on the lines to the North of England, I believe. I am told that at least one more will shortly be delivered, and that machines of this capacity are needed for the Liverpool traffic, which is quite brisk these days.

Don't ask me why the Irish company did not buy British, because I don't know, and I'm not guessing, but anyway the machine with Irish registration, and painted the usual neutral "orange" colour, did not stop long at our airport but left for Dublin with its Irish crew. Orange may not be just the exact colour that the Irish company would have chosen, but there is no doubt that it's a fine colour for neutral aircraft, so far as visibility is concerned.

A slightly sadder departure from our airport concerned another orange-painted plane, now no longer a neutral though. On Saturday the big four-engined Focke-Wulf Condor, belonging to the Danish company, was taken over by a British pilot and crew, probably the first prize crew ever put aboard an aeroplane for a flight. The Danish Captain and engineer went along too, to the unknown destination, and I heard rumours that the very peaceful British pilot who undertook the job was armed with a huge revolver at which he is said to have looked askance until he was reassured by the news that nobody had so much as dreamed of remembering the ammunition.

Don't blame me if this is an official secret—all I know is that the bar was ringing with the yarn all morning, so quite possibly it is not true. Maybe the whole thing was properly arranged, with horse pistol, bullet, wad, ram-rod and powder flask. But I feel somehow that Fred Emney should have come into the picture—with a cutlass.

A. VIATOR.

# DUTCH LINE TO LISBON

THE Amsterdam-Lisbon air route was inaugurated by K.L.M. on April 2, and the first through plane, a Douglas DC3, painted the deep orange colour of the neutrals, arrived at Sintra (Lisbon) airport a few minutes before scheduled time. It had left Amsterdam at 8.00 hours, and had flown non-stop to Espinho (west coast of Portugal) in 7 hr. 15 min. There the plane refuelled, leaving for Sintra at 17.50 hours and arriving at 18.55 hours. Owing to the present international situation the aircraft had to skirt round the north of France, cross the Bay of Biscay, make a detour round Northern Spain, all this involving a tremendous amount of flying over the sea (presumably all outside the 3-mile limit).

His Excellency the Minister for the Netherlands, Col. Steensma (K.L.M. official), Mr. Vasco d'Orey (head of the local firm which represents K.L.M. in Portugal), the president of the Lisbon Municipal Council, Col. Sintra (secretary of the Portuguese National Air Council, Deputy for the Nation, and commandant of the Sintra Air Base), and a large crowd of Netherlanders residing in Portugal welcomed the first Dutch plane to link the two capitals. A rousing reception was given to the popular Dutch hero, Parmentier (of MacRobertson race fame), and his crew, Van Bolkom (relief pilot), Bellm (radio officer) and Smit (mechanic).

No passengers were on board this time. However, ten bags of mail were carried, also some boxes of Dutch flowers, gathered that morning in an Amsterdam garden, and sent by the director of K.L.M. and the Honorary Consul for Portugal in Holland, Mijnheer Voeterlink, to be presented to the wife of His Excellency the President of the Portuguese Republic.

The Minister for the Netherlands made an excellent speech, referring to the airline as marking the beginning of a new era in Dutch-Portuguese relations. He also announced that Her Majesty Queen Wilhelmina had been pleased to confer upon two Portuguese subjects the Order of Orange and Nassau, Col. Sintra (Commander) and Mr. Vasco d'Orey (Chevalier). The Dutch and Portuguese national anthems were played, and the only discordant note was some person standing at the salute in the approved Nazi fashion.

Col. Steensma followed with a well-chosen speech, informing his hearers that the Amsterdam-Espinho-Lisbon line was only a preliminary to a longer route, Amsterdam-Lisbon-Cape Verde Islands-Paramaribo, which would come in due time, and for which K.L.M. were having built a fleet of 4-engined aircraft for the trans-Atlantic section of the trip. While everybody was waiting for the arrival of Parmentier's plane, another Douglas DC3 took up a party of Netherlanders for a joy ride. This was followed by a free trip for the Press, and on this trip the first Amsterdam-Lisbon plane was escorted in.

This new airline will mean that Germans can send their mails and parcels to and from the U.S.A.—for the Dutch plane links up with the Pan-American Clippers service—without fear of interference by the contraband control, which is very nice for the Germans if awkward for the Allies. It may present some pretty problems later.

# SCOTTISH AIR SERVICES

SCOTTISH AIRWAYS, LTD., announce that a new service between Glasgow, North Uist and Stornoway is to be started on April 29. It will operate in each direction on Mondays, Wednesdays and Saturdays, and it should be noted that passengers will require permits to enter the area.

The service between Glasgow, Tiree, Barra, Benbecula, and North Uist, suspended since the outbreak of war, was resumed on April 16, on Tuesdays, Thursdays, and Saturdays. Permits are also required for this area. As from April 15 the schedules are revised for the three other services, Inverness-Wick-Kirkwall-Shetland, Kirkwall-North Isles, and Glasgow-Campbeltown-Islay.

Permits are required to travel on all services except the Glasgow, Campbeltown and Islay route. Cameras may not be carried. The extensions of these air services will be greatly welcomed by holiday-makers, who taxed the company to its capacity last year on all routes. The new time-table issued by Scottish Airways, owing to war restrictions, does not reveal the times of departure of aircraft.

These announcements are heartening at a time when British civil aviation is barely managing to keep its head in the air.

Generally, the story is one of shut-down services, and in England no fewer than nine operators have been forced to cease their services since March 1. The only services now operating in England are those linking Liverpool with the Isle of Man and Belfast; Penzance and the Scilly Isles; and Shoreham and the Channel Isles. In contrast to this serious position in England, Scottish air routes remain relatively unchanged. The pre-war mileage of 2,428 compares very favourably with to-day's total of 2,334.

It is a remarkable fact that while England has suffered badly, Scotland resumes her air transport activity on a scale practically unchanged from that which existed before the war. Of the operating companies in England which have been obliged, as a result of the Government's decision, to cease operations, only one flew into Scotland, and that was by the east coast route from London to Perth. Of the pre-war air services which were operated by Scottish companies only the Glasgow-Inverness line has been closed. So Scotland is not doing so badly, all things considered.

# REFUELLING in FLIGHT

## *A Lecture to the Royal Aeronautical Society*

By SIR ALAN COBHAM, K.B.E., A.F.C., Hon. F.R.Ae.S., and MR. MARCUS LANGLEY, F.R.Ae.S.

THIS 649th lecture of the Royal Aeronautical Society was delivered on April 12, in the lecture hall of the Institute of Electrical Engineers, London, and, after introduction by the chairman, Lt.-Col J. T. C. Moore-Brabazon, Sir Alan Cobham said:—

My experimental work in flight refuelling goes back over a period of ten years, when I became interested in its possibilities as a means of removing the hazard of a heavily loaded take-off. In 1932, initial experiments were carried out on two DH9s and, early in 1933, we continued experiments with a DH9 and a Handley Page W10 transport machine. About this time, the Courier was designed for the purpose of a non-stop flight to Australia, by means of flight refuelling, and a flight to India was arranged. The flight would undoubtedly have been a success, but a throttle broke after the machine had been refuelled at Malta, and a forced landing had to be made.

Considerable data were collected in 1933 and 1934. Systems were developed and equipment made, and in 1935 I came to the conclusion that the correct method for refuelling in flight was briefly as follows:

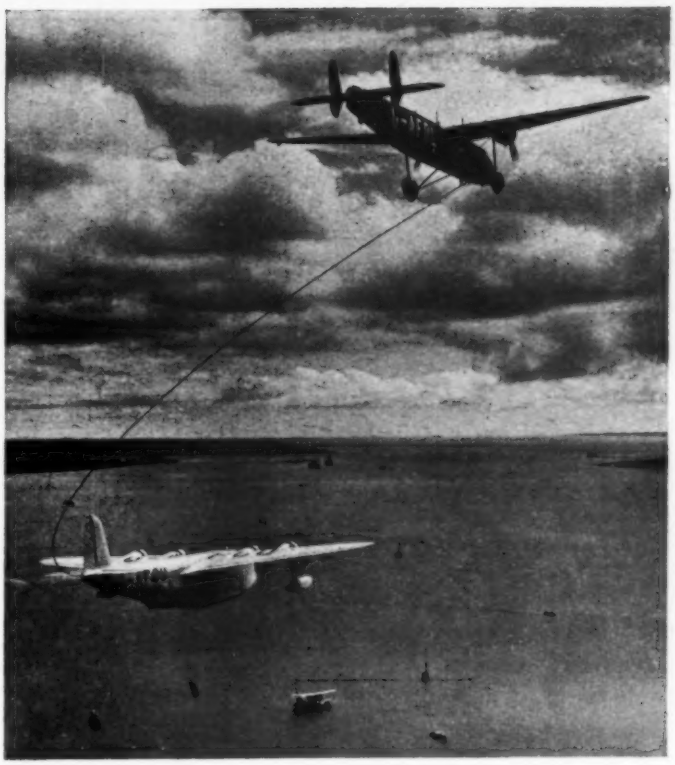
*The tanker (giver) should "formate" on the liner or bomber (receiver), and the hose should pass from the nose of the tanker to the tail extremity of the receiver's fuselage. Furthermore, the tanker should "formate" behind, above, and to one side of the receiving aircraft.* In such conditions, because the hose and the hauling and contacting lines passed over no part of either aircraft, but were behind the receiver and below the tanker, they would not touch or become entangled in the machines if they were to break. We have adhered to that principle ever since.

### *Early Demonstrations*

In 1935 Imperial Airways became interested in Flight Refuelling, Limited. The Air Ministry still continued to support our development work and provided two Virginias. In the summer of 1936, very full demonstrations were given to the directors of Imperial Airways. Our next stage of development came with the AW23 transport machine acting as a tanker; demonstrations were given at Farnborough in 1937, when contacts were made with the Handley Page 51.

Very important trials were done in January, 1938, at Hamble. The tanker machine was the AW23; the liner receiver was an Empire flying boat. Many useful data were collected, as we carried out refuelling in storm, fog, rain and low cloud. We came to the conclusion that, generally speaking, flight refuelling can be performed whenever it is possible to operate air transport. In June, 1938, we conducted a daily sequence of flight refuelling demonstrations, which were operated at precisely 11 a.m. These proved that refuelling in flight could be used for a daily schedule service, under all conditions.

By then we were already working on the problems of the Atlantic service, which was to start in 1939. The boats had been designed for refuelling gear and were to take-off at 46,000 lb., the weight being increased to 53,000 lb. when in flight. The purpose of this service was to continue the development work, and there was no thought that the Empire boats would show the maximum advantages which might be gained from refuelling.



Cabot being refuelled from a Harrow tanker.

Handley Page Harrow bombers were converted into tankers having a capacity of 900 gallons, and the first two of these were shipped out to Newfoundland in charge of Flt. Lt. Johnson during April. In the meantime the boat crews were given some four hours' flying experience of the process at Ford. The first officer was in charge of refuelling and he was assisted by the second wireless operator. The captain of the boat required no more than ten minutes verbal instruction as he had only to fly a straight and level course. In actual practice the automatic pilot had charge of the flying boat on more than one occasion during the whole time that fuel was passing. The tanker for the Irish base at Foynes was in charge of Flt. Lt. Tyson.

### *The Atlantic Service of 1939*

The service did not actually begin until the departure of *Caribou* on its first west-bound flight on August 5, 1939, and ended with the arrival of *Cabot* on October 1, 1939. Sixteen crossings were made within this period, and the refuelling operation was successfully performed on fifteen occasions. On the other occasion it was unnecessary because there was a very strong westerly wind.

The average time between making contact and turning on the petrol was five minutes, and the limits were three and seven minutes. The passing of the fuel was almost consistently seven to eight minutes for 800 gallons.

The conclusions drawn are as follows:

1. The refuelling equipment was adequate and requires no major modification. Labour would be saved if the units were mechanised. The addition of a flow meter is very desirable.
2. The tankers require adequate wireless. They must be fitted with homing and blind landing sets.
3. The Harrows were suitable aircraft for tanking the Empire boats, but for larger and faster airliners it would be necessary to have more advanced

## REFUELLING IN FLIGHT (CONTINUED)

tankers. It is not necessary to build special tankers since certain obsolescent aircraft would be available. For example, when the Empire boats are superseded they would make admirable tankers. The operating and "formating" speed of the tanker (with hose pipe down) must be such as to allow an adequate margin for formating above the stalling speed of the receiving aircraft. Thus, if the latter is to be loaded to 60 lb./sq. ft., then the tanker must be able to refuel at not less than 150 m.p.h. This means that the tanker should have a cruising speed approaching 200 m.p.h. The engines of the tanker need not be supercharged to more than 6,000 ft., as the operations were never done at more than 3,000 ft.

### *The Refuelled Airliner*

The S30 flying boats used to operate the 1939 summer service were not capable of taking full advantage of refuelling. They were underpowered and of insufficient structural strength to carry any load greater than 53,000 lb. Nevertheless, the margin between that load and the load which they could actually take-off the water made a considerable difference to their revenue-earning capacity. They were definitely worth operating, but future types can now be designed to show an enormous advantage.

The next generation of airliners which is to operate long-range services should be designed from the start to take advantage of refuelling. The machine must be of sufficient strength to allow of its carrying 50-60 lb./sq. ft. The hull bottom (or the undercarriage) need not be stronger than is necessary to take 30-35 lb./sq. ft.

The take-off power should be such as to give a power loading of 7-10 lb./b.h.p. at take-off weight. The cruising power loading will then be of the order of 20 lb./b.h.p. at the refuelled all-up weight.

It scarcely needs stating that the more work which can be given to a particular refuelling base the cheaper will be the service. The Irish and Newfoundland bases could with ease have handled ten or more services per week with very little additional operating expense. Even ten services would only have demanded ten hours flying weekly.

It must be remembered that a refuelling base is mobile and can very quickly move with the seasons of the year, and with the political situation.

Several methods of making contact may be used, of which two are:

a. The ejector method.
b. Taking-off in contact.

In the ejector method, the receiver, after taking-off, trails its 10-cwt. steel hauling line and sinker weight through the receiver coupling in the tail. The tanker flies up behind, to one side and slightly below the receiving aircraft. From an opening in the side of its fuselage it fires a projectile and line from a B.S.A. line-throwing gun for life saving at sea. The thrown line, which is a 5-cwt. flexible steel cable, slides down the line and engages with the grapnel on the sinker weight. The sinker is wound up into the hatchway on the underside of the nose of the tanker, and after it has been detached from the hauling line by means of a bayonet fitting, the line is plugged into the nozzle of the hose pipe. The hose pipe is now lowered away, the tanker in the meantime having climbed into a position above, behind, and to one side of the receiver.

As the hose pipe is lowered, the receiver hauls the nozzle into the receiver coupling in its tail and the hose and pipe lines are flushed with nitrogen from the tanker. The refuelling operation then begins and, when all the fuel has flowed, the pipe lines are again flushed with nitrogen.

As the nozzle breaks away from the coupling a methyl bromide bottle is automatically opened and removes all fire risk from static discharge. As the nozzle leaves the coupling it carries with it the hauling line and then a false hauling line, until some 300ft. have run off the windlass. When the two aircraft move away from each other, a weak link in the line is broken in mid-air, some 75ft. from each aircraft, and any spark which might occur at the breaking of contact is away from all danger of fire.

### *Take Off in Contact*

This method of making contact in the air has several advantages over those previously used. The aircraft are flying on parallel courses throughout the whole process. The tanker has only to climb into an upper position after the grapnels have engaged. Provided that the aircraft are in their correct relative positions, the lines must always engage and the method can therefore be used at night.

Taking-off in contact has further advantages. The two aircraft take-off simultaneously connected by a light line from the wing tip of the tanker to the reception coupling of the receiver. When in the air, this light line is released from the wing tip and is used to pull the main hauling line across. This in turn is used to haul the hose pipe across. The transfer of the hauling line can begin the moment the aircraft have left the ground, and in this way as much as 1¼ minutes may be saved in the actual operation of refuelling, and 3 minutes in the total flying time.

At this stage of the lecture, the delivery was taken over by Mr. Langley, who dealt with the theoretical requirements and advantages of refuelling in the air.

### *Wing Loading*

Throughout the history of aircraft design there has been a constant tendency to increase wing loadings. In pre-war days the limit was less than 10 lb./sq. ft., but this has risen now to 30 or more. In return for this increase in loading, designers have been able to give ever-increasing speed, but they have paid the price in the raising of landing speeds and the length of take-off runs.

Vessey and Belart, ignoring the practical restrictions of take-off climb and landing, have considered what would happen if the wing area of an aeroplane were gradually reduced, leaving the weight and power constant. Vessey found the optimum wing loading of a typical modern monoplane to be 62 lb./sq. ft. Belart showed that the Douglas DC2 would benefit 6 per cent. in speed by an increase in the wing loading from 19.8 to 49.6 lb./sq. ft. In the Heinkel 70 there would be a gain of 11.15 per cent. in speed, following an increase from 18.5 to 72. At such loadings no aeroplane could leave the ground.

The condition of a heavily loaded aeroplane, having a low rate of climb, at the moment of withdrawing the assistance of ground boosting, catapults, runways, and so forth, is extremely hazardous. The failure of only one power unit will encroach upon its power reserve and reduce its rate of climb to a negligible, or even negative, quantity.

It is obvious that lower power loadings (i.e., high-powered engines in relation to the weight) are not profitable, but low-power loadings have been forced upon aircraft operators by take-off and climb considerations. The ideal arrangement is that which gives a low power loading for the take-off *and climb to a safe operating height*, combined with a high and profitable power loading, during the period of level "cruising power" flight.

### *Aerodrome Size*

SUGGESTIONS have been made that aircraft efficiencies would improve if longer take-off runs were permitted. This implies, first, that aerodrome sizes would have to be increased, and, second, that the I.C.A.N. take-off regulations would have to be relaxed.

Regarding an increase in the sizes of aerodromes, one must face the fact that already, owing to their size, they are having to be put too far from the centres of population.

Aerodrome area increases as the square of the runway length, which in turn varies as more than the square of the wing loading, power remaining constant. Thus, an aeroplane having a take-off run of about 300 yards at 30 lb./sq. ft. wing loading would require over 500 yards

at 40, over 800 yards at 50, and if a normal take-off were required at 60 lb./sq. ft., the distance would be nearly 1,300 yards. Doubling the wing loading increases the length of run by more than four times and the area of a square aerodrome to give this run in any direction by more than sixteen times.

Regarding the I.C.A.N. regulations, one must be extremely careful before agreeing that any relaxation is desirable. An increase in the permissible "unstick" distance would probably encourage the use of many aeroplanes having highly dangerous qualities.

### *Refuelling and the Diesel*

Military aerodromes are in wartime one of the most important and vulnerable targets for attack. In such conditions, runways might be seriously damaged and a very restricted area left. This would seriously restrict the load which bombing aircraft could take. Where prepared aerodromes of large size are unlikely, the effectiveness of military aircraft might be seriously reduced. In both these examples, refuelling offers a completely mobile method of overcoming the effects of enemy action or natural conditions, or offers a big increase in useful load.

There is another application of refuelling in flight, the refuelling of an aircraft along its route. For example, at the Azores, with so little commercial or tourist trade, a landing can hardly be justified. The harbour facilities are poor, and for land aircraft the position is even worse. A tanker having a relatively light loading could operate. The only requirement is adequate wireless communication, whereby the transport can give notice of its approach and its requirements. The tanker must be equipped with D.F. gear, so that the two aircraft may "home" on each other if visibility is poor. We understand that this "homing" in flight has actually been tried, and works successfully.

Another example of such non-stop refuelling may be found in the case of an aircraft running short of fuel towards the end of a long journey. At present, the tendency is to carry a large excess of fuel against the contingency of a continuous head wind. Only on a few occasions is this excess of fuel justified, but if it were not there, the results would be catastrophic. If, however, the aircraft were equipped for refuelling in flight, it could cut down its reserve fuel and rely on a tanker coming to meet it on the few occasions when the excess were necessary.

Two hundred and fifty pounds of refuelling equipment is only a fraction of the weight of two hundred and fifty gallons of fuel, and yet this is frequently left in the tanks after a transatlantic crossing.

With regard to diesel engines, their development has been very restricted in recent years and petrol engine advancements no longer allow the claim of great fuel economy (in weight). The cheapness of diesel fuel and the reduction of the fire hazard are good selling points with air transport operators. Refuelling would perhaps prove to be a substitute for ground boosting and would thereby remove one of the limitations on the diesel, as it could not provide the high power at take-off which the petrol engine could.

The slides shown made clear the method of connecting the two aeroplanes by the fuel line and explained by means of graphs the advantages to be derived from high wing loading. The actual paper is longer than the summary given here and contains a full theoretical treatment.

### *Discussion*

Flt. Lt. Tyson, who has done much of the flying associated with the work, said that flying a tanker is not tricky but is simply a straightforward job of accurate formation flying. The presence of the hose cannot be noticed by either pilot, and pilots of average ability can be trained to the work in a week or a fortnight. He was of opinion that refuelling could be done in all weathers and at night.

Dr. Roxbee Cox considered that refuelling in the air was important as it allowed aircraft of normal capabilities to be changed into long-range machines. Some people thought that refuelling was merely doing something now by a certain means which we would be able to do later by other and better means, namely, improved aircraft, and that it was therefore only an "interim" method. He, however, did not regard it as such. He used to belong to a school of thought which considered that aircraft should be self-contained, but confessed that the work done over a period of years on flight refuelling had rather shaken his opinions. He thought that jettisoning was nearly as important as the main problem, that "defuelling" had to be studied as well as "refuelling." Before he could be convinced of the necessity of refuelling he would have to see the economies of it worked out. Should the objective of transporting a certain commercial load be attained by using an aeroplane of a certain size and refuelling it, or by using a slightly larger aeroplane which would be flown at a lower wing loading without the necessity of refuelling? The answer lay entirely in the relative costs, he thought.

Sir Alan, in commenting on jettisoning, said that the petrol must be discharged clear of the disturbed part of the air flow. He instanced the case of petrol which had been discharged out of the tail and had been blown along the top of the fuselage on to the windscreen. On the subject of take-off run, he pointed out that, though a theoretical calculation might show that 1,000 yards was required for standard conditions at sea level, places like Kisumu were 4,000ft. above sea level and the temperature was such that the place was equivalent to about 10,000ft. in the standard atmosphere. The disadvantages of high wing loading at take-off were much more apparent outside England. In a doubtful take-off the pilot had only about three seconds to make the important decision whether he would go on or shut his throttle and apply the brakes.

### *Risks and Accomplishments*

Lord Sempill, after congratulating the lecturers, said that as no vast improvements in design were to be expected, it was necessary to make much better use of the aircraft we have, and refuelling was one way of doing this. He considered the work to be very useful and its progress was being followed from the naval angle with close attention.

Mr. Masefield commented on the necessity for thinking quickly in wartime and thought that the lecturers had done so. But the Air Ministry had not appreciated their work so far and, under its direction, the building of bigger and bigger flat-climb bombers was proceeding. Someone had called the method of getting such aircraft off the ground the "assistance by prayer" method. He pointed out the vulnerability to bombing of a long runway and thought that, in bombing, the desirability of having the "eggs in several baskets" was obvious, and that this was an objection to the increase of bomber size.

Mr. Hessell Tiltman saw in refuelling a contribution to the salvaging of international relationships by making the long range machine more effective and so helping to increase the speed of social intercourse across the world. The aid which refuelling might give to the development of the diesel, with its reduction of fire hazard and elimination of radio interference, he considered important. It was necessary to design a machine for refuelling as nothing at present available could carry 60 lb./sq. ft. So that research could be done at even higher loadings, he thought that a machine capable of carrying 70 lb./sq. ft. at a factor of 6 should be constructed.

Mr. Ellis also paid tribute to the lecturers, and Mr. Preston asked questions on the flushing with nitrogen, which Sir Alan explained. The chairman, in proposing the vote of thanks, said that inertia to a new idea was the usual state of affairs. The higher power output of the petrol engine had certainly pushed the diesel back, but high octane fuels were very expensive, and after the war it would be useless to try and convert military machines to civil purposes as they were completely unsuited. Finally, he proposed a vote of thanks and said that we must all be very grateful to Sir Alan and Mr. Langley "for the risks run and the accomplishments made" in their important work.

---

### *France's Flying Equipment*

APOLOGIES are offered to our readers for the omission from this issue of an instalment in the series of descriptions of French military aircraft. Another important French type will be described and illustrated next week.

# CORRESPONDENCE

*The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.*

## WESTERN AIRWAYS

### *Continuation Essential*

I SHOULD like to refer to Lord Apsley's letter in your issue of April 11 concerning the closing down of Western Airways, through the requisitioning of their aircraft by the Government.

As we all know, it is essential that the normal business life of the community be continued during wartime; and may I add at once that one of these essentials is the air service linking Weston-super-Mare with Cardiff?

A map of the West country will show that nowhere in Great Britain does geography play such a vital part as in the area surrounding the Bristol Channel.

Many thousands of passengers have been carried by the Weston-Cardiff planes during past years, necessitating not only an hourly service, often running in duplicate, but also a regular night service.

Further, a great saving in time and expenditure is incurred; for instance, to travel to Cardiff from Weston by train takes roughly two hours, whereas by flying direct across the Channel the time taken is ten minutes. Again, the fare by plane is cheaper than the third-class rail fare.

Surely these facts justify the continuation of this air-service even in wartime. GORDON MANCHESTER.

Weston-super-Mare.

### *Some Comments by the Founder*

LORD APSLEY has invited correspondence on the subject of Western Airways, and, as the founder of this Company and responsible for the conception and initiation of the Weston-Cardiff Service and Weston Airport, my views may be considered equally authoritative as Lord Apsley's.

In the first place, Lord Apsley has, in all probability, quite misunderstood the issues at stake. Has he heard of petrol rationing? My personal and operative experience of the route enables me to state that the petrol consumption would be equivalent to furnishing no fewer than 2,500 hard-hit business motorists with an extra 10 gallons a month, and I leave judgment on the relative merits to the commonsense of your readers.

I am at present well acquainted with a situation which would enable the "veteran aircraft" of Western Airways to be utilised on work of vital national importance, and this without reflecting, in any way, on the Ministry's conduct of rearmament and the "true facts of the aircraft position." The Air Ministry is, of course, well aware of this situation. Further, information will shortly be made available, which will show that, quite incidentally, the decision of the Air Ministry is in the best interests of the public.

Lord Apsley indicates the result of the Ministry's action on the Company's 100 employees, "many of whom have been with the firm since 1932." In the interests of accuracy perhaps Lord Apsley would prefer to substitute for this remark the statement that, in fact, no employee of the Company in 1932 is employed by Western Airways under Mr. W. Straight—employees whose foresight, loyalty, and untiring work resulted in the amazing growth of the Company and its exceptional safety record.

Lord Apsley waxes satirical in his concluding paragraph. He has apparently overlooked the evidence furnished to the Weston Licensing Bench, irrefutable and unrefuted, on the occasion of the opposition to the liquor licence at Weston Airport, the circumstances of which must be fresh in his recollection. NORMAN EDGAR.

White Waltham Aerodrome

## STANDARDISATION

### *The Extrusion Problem*

THE correspondence in your issue of February 29 struck a timely note of warning with regard to the present intensive expansion of the Royal Air Force.

The multiplicity of types of aircraft being constructed, and the lack of uniformity of design in the case of many structural parts and details which in various degrees are adaptable to standardisation, must certainly be retarding the output of military aircraft as well as complicating the problems associated with stores, repairs and the recovery of scrap materials.

In the article by Mr. Robert Lickley (February 8, 1940), referred to by Mr. J. F. Cuss, the point was emphasised that standardisation of design as a whole is impossible, particularly as regards the fuselage, the design of which must be dictated by the military purpose of the aircraft. On the other hand, some measure of standardisation undoubtedly could be introduced into such structures as engine mountings, and even spars, possibly on the lines of basic structures which could be scaled up or down to suit particular needs. Such standardisation would, of course, need to be the subject of a good deal of careful collaboration in order to avoid unnecessary delay in the evolution of promising new designs.

One of the most important needs of the aircraft industry at the present time is increased supplies of light alloy extruded sections and sheets, especially the former, and, although some progress has been made towards greater use of standard sizes of sheets, the absence of any attempt to produce a set of standard designs for extruded sections, beyond a few simple angles, is remarkable. Even the dimension tolerances on light alloy sections are not uniform. This is a major cause of the extrusion presses in this country being taxed beyond their capacity at a time when the potential consumption of extruded light alloy sections by the aircraft industry is increasing rapidly.

I am sure it will be agreed that the foregoing brief comments indicate the urgent necessity of much closer collaboration between the Air Ministry, the constructors and the light alloy manufacturers than has hitherto been the case.

Northern Aluminium Co., Ltd., H. F. JAMES.
Banbury, Oxfordshire.

## KEEPING THE SCORE

### *A Suggestion for Comparing "Aces"*

MAY I put forward a suggestion for showing the number of enemy aircraft machines brought down by our pilots in *this* war?

In the last war, as most people know, we had no parachutes and so one had no chance of "jumping off" from a machine on fire or out of control, and so if you had been lucky enough to bring down, say six enemy aircraft, and then your aircraft was damaged beyond a safe landing, you brought down no more.

Now, all is different, thanks to parachutes, and one has a second and a third chance; in fact as many chances as your parachute and luck holds out.

I suggest that a stroke drawn after the number of enemy aircraft brought down, indicates a "jump," e.g., 2/2 indicates two enemy aircraft brought down on his second chance.

We will then be able to compare "Aces" of this war with those of 1914-1918 on a more equal basis. H. W.

London.

## FORMATION FLYING

### *Three Distinct Regions*

THE following points may be of interest in connection with Dr. Lanchester's article in *Flight* of March 28, 1940.

When flying in "V" formation with either monoplanes or biplanes, there are three distinct regions in which it is possible to fly the wing machines.

The first is outside the influence of the leader's machine and is about two spans between wing tips.

The second is between two spans and half a span when the wing aircraft has to be held in to the leader by use of rudder and aileron.

The third is closer than half a span; when in this position the wing machines must be held *away* from the leader; in other words, there is a tendency for the machine to be drawn towards the leaders.

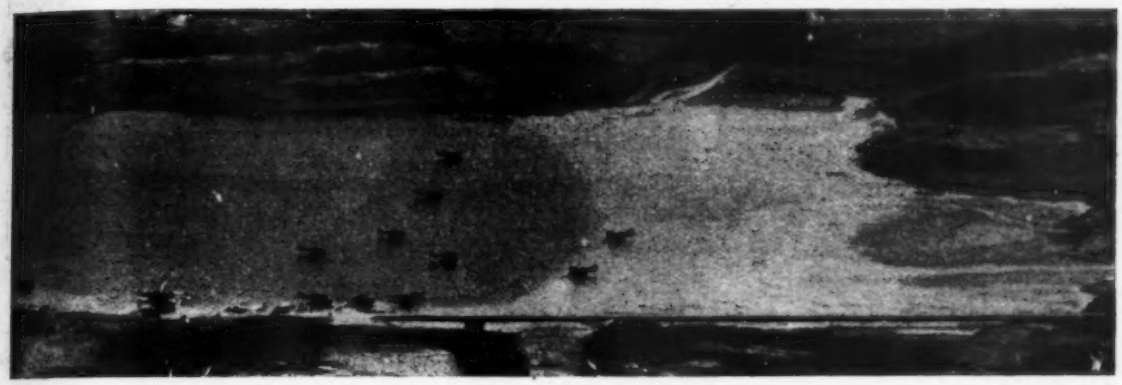
It is, however, very well established that close-formation flying leads to the wing machines using more petrol than the leading aircraft.

Although there may be a gain in aerodynamic efficiency, this is more than offset by the coarse use of the throttle necessary to keep close formation. F. H. DIXON.

The Fairey Aviation Co., Ltd.

# WAR in the AIR

*Raiding Air Bases in Norway and Denmark : R.A.F., F.A.A., and Fleet Co-operate*



**A ROYAL AIR FORCE PICTURE OF STAVANGER. According to the official inscription on the back of the photograph, the machines on the water are Blohm and Voss seaplanes. To us three appear to be Heinkel He 59s and the rest He 115s.**

THE chief air event of the past week has been the series of attacks by the R.A.F. and the Fleet on Stavanger airport. The aerodrome there is—or was—the finest in Norway, and attached to it is a seaplane base. It was being used by the Germans for a concentration of aircraft which might be used to establish air superiority in Norway, and also for landing numbers of troops from Ju 52 transport aircraft. It was, therefore, most important for us to make it as uninhabitable as possible at the earliest moment. Before proceeding to describe the operations, our readers will be interested to have a description of Stavanger itself, and a correspondent has sent us the following account.

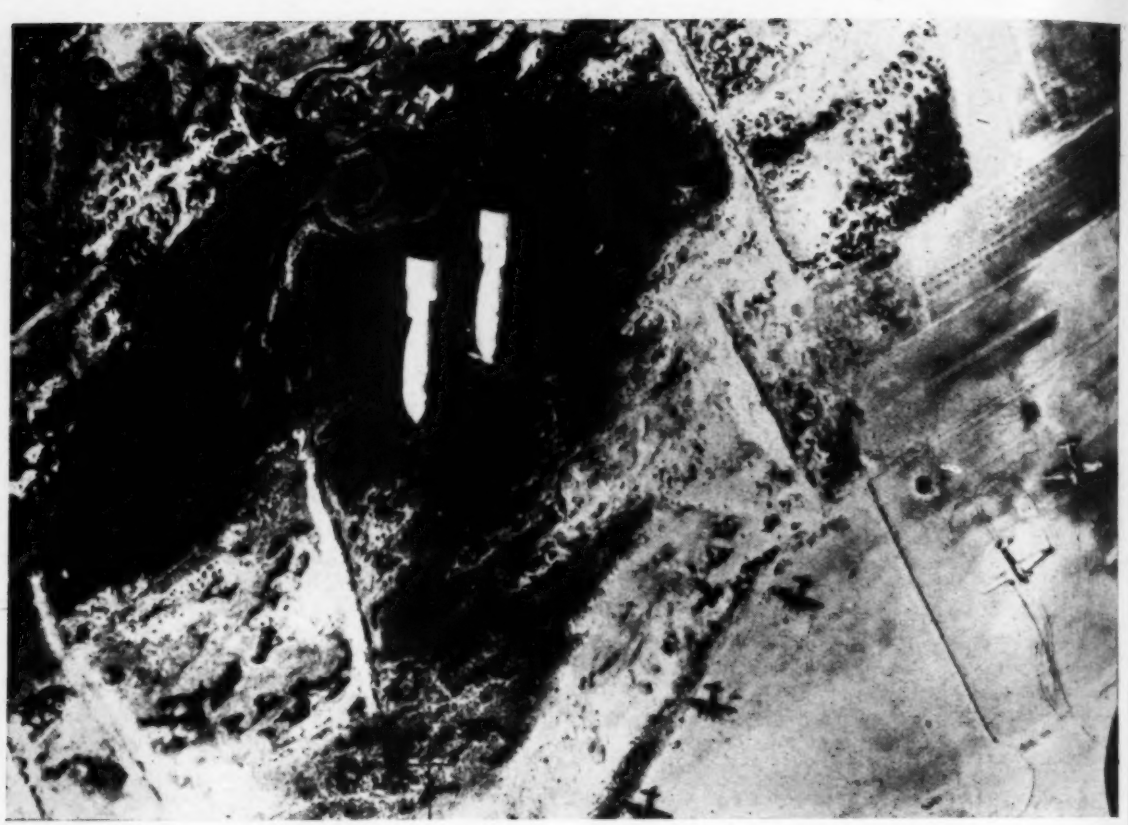
"It seems only a week or two ago," he writes, "since I had my first breath-taking view of Stavanger and its famous fjord from 2,000ft. above the North Sea as we approached the Norwegian coast. On the evening of my arrival from Perth I sat, at a banquet, next to an officer of the Norwegian Air Force, and from our conversation on that occasion, what I saw for myself, and from my own experience of aviation, I came to one or two conclusions, one of which was to the effect that if an enemy of Great Britain ever got a base at Stavanger the northern half of Britain's east coast should get busy with its A.R.P. drill. The reason is that Stavanger is perhaps the finest combined seaplane and landplane base in Europe. Incidentally—and this is a point of topical interest—I crossed the North Sea in a landplane and yet the machines used in the *internal* airlines in Norway were seaplanes. Norway has few flats, but hundreds of lakes and inland waterways, which make the floatplane or flying-boat the ideal machine. Narvik was a vital necessity to Germany for her armament production, but Stavanger, the Scapa of the eastern coasts of the North Sea, was as important as a base for sea patrol and reconnaissance on this side of the former 'German Ocean.'

"Stavanger Aerodrome, with its concrete runways, one of them 1,000 yd. long, is better than anything we have in this country as a landing ground, and, over and above that, there is the seaplane base and fleet anchorage in Stavanger Fjord—for this project was carried out with Norwegian thoroughness. From the air and on the ground I saw the efficiency of the planning of Stavanger's airport. The broad, flat peninsula on which the aerodrome was built is one of the few level areas in the country, and full advantage has been taken of the fact. The nearest hills are a few miles away, so that it has a safe approach in thick weather, the safety being contributed to by an up-to-date radio direction-finding installation. The fjord is also an amazing piece of Nature's handiwork. It is not one of the deep, narrow waterways which make the typical beauty of Norway. It is a long, broad seaway, blue as the Mediterranean on a summer day, and there are about two thousand islands in it. Some are mere dots of grass-grown rock a few square yards in extent, but, looking eastwards over the fjord from the tower situated on a height in the middle of the town, the island-studded water ringed by the distant blue hills made a picture of indescribable beauty. In the north-west was the open water, well sheltered from the rough North Sea by the peninsula on which the long white fingers of the land aerodrome's runways lay in their criss-cross pattern, and it was on this seaway that the Junkers planed down to a safe anchorage on their flights between Bergen and Oslo."

## Smashing Up Stavanger

IN the operations against German forces along the Norwegian coast the Fleet Air Arm has taken a notable share. Even before Stavanger became the chief target the F.A.A. had been very active, and on Saturday, April 13, some of its machines had attacked warships, transports, and supply ships at Bergen. The ships were bombed, a warehouse full of munitions was blown up, and a motor torpedo boat was machine-gunned. The weather was very bad and one of our machines was forced to alight on the sea near an island. The crew of two were seen to get out of their machine. On Tuesday, the 16th, the F.A.A. went to Bergen again and sank one transport, besides getting a hit on a submarine which was on the surface.

On Monday, April 15, long-range bombers of the R.A.F. made a heavy attack on Stavanger. For nearly an hour the Stavanger air bases were subjected to a sustained attack, during which extensive damage was caused by large numbers of high-explosive and incendiary bombs. Aircraft arriving on the scene after the raid had begun were able to identify their target for many miles out at sea by the light of fires started in earlier attacks. Over Stavanger, a red glow suffused the sky and aircraft could be seen blazing fiercely at the southern end of the aerodrome, enveloped in swirling clouds of black smoke. Direct hits were obtained on the runways, one heavy bomb burst close to the aerodrome control tower and another started a fierce fire nearby. In excellent visibility, given by the



**Another picture of Stavanger, with what appear to be two 500 lb. bombs going down. On the right are two Junkers Ju 52 transports, the remainder of the aircraft seem to be Junkers Ju 88 bombers. Two large bomb craters are visible near the 52s.**

light of the moon, the bombers traversed the aerodrome in successive waves of attack, destroying aircraft and buildings, pitting the aerodrome surface with bomb craters and leaving the base aglow with the light from many fires. The raiders encountered opposition from the Stavanger ground defences. Searchlights strove vainly to hold bombers approaching singly from different angles to launch their attack. Batteries of light anti-aircraft guns, which encircled the landing ground, set up a barrage of fire over the centre of the target. Despite opposition from ground defences all our aircraft returned safely from Stavanger to their bases early next morning, though two Coastal machines working over the North Sea failed to return.

In one of the attacks the crew of one of the British aircraft reported seeing a sudden red glow, apparently caused by a big explosion. "I've never seen a Brock's benefit night," said one of the young pilots, "but the Germans in Stavanger might have been having one last night. The air was simply alive with blue and orange searchlights, rockets, and shells which burst into groups of four bluish-white stars. We sailed through it all and dropped our bombs right on the target. My rear gunner sprayed bullets down the beam of one blue-pencil searchlight which picked us up. The light went out at once, and remained out."

Blenheims played a part in the Monday's work, and they sank two German seaplanes at their moorings. It was a day of stormy weather and the Blenheims made their attack during a snowstorm, which probably inconvenienced the anti-aircraft gunners on the ground as much as it did our bomb-aimers.

The raiding was continued, and by the evening of Thursday, April 18, seven severe attacks had been made on Stavanger and a great deal of damage had been done. On Tuesday, April 16, the R.A.F. varied the proceedings by a visit to Trondhjem, which was beginning to assume no little importance after the landings of British troops at various points on the coast had taken place. The raid by the R.A.F. was made by night, and a large fire was seen to break out as a result. Then a seaplane base in the neighbourhood was raided. Owing to the mountainous nature of Norway and the numbers of fjords, seaplanes loom rather large in the operations.

On Wednesday, April 17, the Fleet took a hand in the harassing of Stavanger. Early in the morning naval forces subjected the aerodrome to a heavy bombardment for an hour and twenty minutes. As our ships withdrew, German aircraft tried to bomb them. Fighters of the Fleet Air Arm engaged the enemy aircraft. They shot down one Heinkel and one Dornier flying-boat, while two more Heinkels and another Dornier 18 were damaged. None of the Fleet fighters was shot down, but the Germans landed a bomb on one of our cruisers. She was damaged, but steamed on and reached her base. H.M.S. *Gurkha* remains the only moving warship to have been sunk by an enemy bomb.

After the Fleet had withdrawn, the R.A.F. resumed its operations against Stavanger, where a large number of enemy aircraft was seen to be dispersed round the edge of the aerodrome. High and low-flying attacks were delivered by a strong force of bombers. Direct hits were observed on the runways and bombs were seen to burst among the transport aircraft parked on the south-west side of the aerodrome. The attack lasted for over an hour. Fighter opposition was encountered. In addition to the aircraft which were destroyed on the ground, two twin-engined enemy aircraft are believed to have been shot down.

The same aerodrome was again attacked by our aircraft during the night and further damage was reported.

Our general reconnaissance aircraft continued to patrol the fjords and islands off the Norwegian coast. A low-level bombing attack was made on a submarine and one hit was observed. A supply ship was also attacked. Three

of our aircraft engaged in these operations have failed to return.

That day a Sunderland flying-boat landed alongside a British destroyer in a Norwegian fjord and had a narrow escape. Six German aircraft attacked. They were four Junkers 88 and two Heinkels. Circling at about 5,000ft., the Junkers made level bombing attacks. The Heinkels used diving tactics. The attack on the destroyer continued for some time, but although 24 bombs were dropped no damage whatever was done. The bombers then concentrated their attention on the flying-boat. While some of them machine-gunned it, another dropped six incendiary bombs around it. All the time the flying-boat zig-zagged on the surface of the water, an officer in the upper observation dome watching the release of the bombs and successfully guiding the pilot so as to evade them. As the flying-boat dodged about on the water the crew brought seven machine-guns into action against the raiders, who withdrew, having caused no more damage than a wound in an officer's knee and two bullet holes in the fuselage. The Sunderland got back safely to Scotland, though the Germans claimed that both it and the destroyer had been sunk by bombs.

A young Canadian pilot of the Bomber Command who took part in one of the raids on Stavanger gave the following account of his experiences. He comes from Ontario. "We had been standing by from early morning," he said, "but we didn't take off till about midday. We were told to look for German ships. We came into perfect weather within thirty miles of the Norwegian coast. Then we saw a spotter machine, a Messerschmitt 110. He didn't attack, just went like blazes for the shore. We kept straight on to the mainland. I could see snow on the hills and a lighthouse on an island that looked exactly like a cruiser, complete with control towers. As a matter of fact, I thought for a moment that it was a cruiser. We came to within about a mile of the coast and quite close to Stavanger. The sun was very bright and it was rather difficult to see—but the land looked very green. From this point we turned along the coast to starboard. Meanwhile, three Messerschmitt 110s were forming up to attack us above and behind. The first attack came and we pulled away in a single section—a section being three. We went down on to the sea, so low that the under-turrets were wet from spray. We do that so that we cannot be attacked from underneath. Soon attacks were coming from every direction. The section was flying 'as one machine.' The chaps were grand; we were so close together—and such a big machine takes a bit of handling. The Messerschmitts were attacking singly, in quick succession, from opposite sides. At one time they came in on an attack so close that I ducked my head instinctively. I thought they were going straight through us. I could see the blue smoke coming out of the old *canon;* it looked like a lighted cigarette, and the trail of smoke from the machine-gun bullets. But you haven't time to think when you are waiting for him. When the Messerschmitts were attacking us we waited for them until just before they opened fire. They got a few bullets into our other two machines, but nothing serious, and my machine came away without a scratch."

The section to which the young Canadian pilot belongs was able to claim two Messerschmitts definitely down in the sea. "I think one or two of the others felt uncomfortable, too," he added.

## The Bombing of Aalborg

ON the night of Saturday, April 20, the R.A.F. turned its attention to Aalborg, the aerodrome in North Denmark from which the Germans were flying reinforcements across to Norway. Bombs were dropped from a low height, and damage was caused to a hangar. The British bombers came in singly, and the first to arrive found the aerodrome plainly marked with night-flying illuminations. Evidently the Germans had not thought A.R.P. necessary in occupied Denmark, though that they should treat the R.A.F. with so little respect is surprising. Our raid took the enemy by surprise, and for some time there was no fire from the ground. One searchlight beam was exposed, but machine-gun fire put it out. Our bombers flew low, and presently were met by fire.

The pilot of one of the bombers said:—

"My aircraft was the first of the formation to reach the aerodrome, the boundary lights of which were on. So were the obstruction lights on the buildings. While looking for a suitable target we flew practically alongside a German transport aircraft. It was signalling, presumably asking for permission to land. My rear gunner immediately gave him something else to think about, and we got in a good burst of fire before the German disappeared into the clouds. That little incident over, I decided to go in and bomb. We could see three hangars in a half-moon shape. We made our run over some billets and a wireless mast. The rear and front gunners were both 'strafing' the aerodrome as we flew over and dropped our bombs. It must have been a shock for them. They were obviously not expecting us. Most of the ground lights went out after the first explosion, and a solitary searchlight came into action." Aalborg has since been raided repeatedly.

At the same time other formations attacked Kristiansand and Stavanger. At Kristiansand a number of enemy aircraft were seen dispersed on the aerodrome and were attacked with bombs. In the case of Stavanger bombs were dropped, a number of which were seen to hit the runways. The burst of another bomb was followed by an explosion on the aerodrome. Bombs were also dropped on the seaplane base nearby. These attacks were carried out by strong forces, and all of the large number of aircraft engaged in the operations returned safely to their bases.

## The Fleet Air Arm Busy

THE doings of the Fleet Air Arm during the operations at Narvik and Stavanger have now been described in more detail. On the evening of Friday, April 12, its aircraft reconnoitred Narvik and its environs and attacked the German destroyers. On their return they reported that they had made two hits on one destroyer and one on another. These good shots probably simplified the task of the *Warspite* and her colleagues which steamed in next day. On that day, too, the F.A.A. machines were up, and they synchronised their attack with that of the warships, again claiming two hits. German aircraft had landed on a frozen lake nearby, as there is no aerodrome very close to Narvik, and the F.A.A. visited that lake in turn and destroyed several of the enemy machines there. On ice a near miss may well cause an aircraft to sink. When the Fleet bombarded Stavanger on Wednesday, April 17, the naval aircraft helped to protect the ships from air attack. Some of them made as many as three separate flights during the day, and they definitely shot down one Dornier and one Heinkel, besides damaging other enemy aircraft, without loss to themselves. On Saturday, April 20, the Admiralty issued a communiqué which stated that "intermittent air attacks on our naval units and transports have occurred during the past two days, increasing in intensity to-day. The enemy, however, obtained no hits upon either ships or transports, while three of their aircraft have been shot down and others damaged. News of the destruction of the third of the enemy aircraft was received in the following signal from one of H.M. ships: 'Bombed again. Have shot him down.'"

On the same day the enemy dropped many bombs over Namsos, where some of the British troops have landed. They did extensive damage to the town, but the only Allied loss was the trawler H.M.S. *Rutlandshire*. There were no casualties to Allied troops.

The change to fine weather caused much air activity to break out over the fronts in France and Germany. Our Hurricane pilots, as usual, displayed the utmost contempt for odds against them, and attacked enemy formations wherever they were found. As a result of two days' fighting five Messerschmitts 109, one Me 110, and two Heinkels were shot down. Two other Me 109s are believed to have been seriously damaged, probably destroyed. One German pilot was killed when his parachute failed to open. One of our pilots was slightly wounded, but brought down his machine safely, and another was forced to land with the pilot unhurt. The French pilots brought down one German fighter and one reconnaissance machine in France, one of their own machines having been forced to land within their own lines.

"Flight" photograph

**The Hills black-out panels at the Hordern-Richmond factory.**

## Enlightened Works

IN so many of the works which we visit, we hear the same story of grumbles against working continuously in artificial light. This is necessitated partly by camouflage and partly on account of black-out regulations, and there does seem a sense of heaviness despite the fact that nearly all modern factory lighting has a very high content of ultra-violet rays. It is to make up for a deficiency of these rays that town workers go to the country and seaside for their holidays. It is then of interest to note the arrangements for combating this which have been made at the new Hordern-Richmond factory in which De Havillands are interested. The roof lights have over them galvanised iron panels, which are linked together in such a way that the operation of a chain and sprocket will cause them either to lie flat, overlapping each other (black-out and camouflage condition), or stand vertically, when over 85 per cent. of the normal amount of light is admitted. The galvanised iron panels render the roof-lights splinter proof and the black-out condition complies with Home Office regulations. Operation is very speedy and there would be plenty of time to lower the panels after receiving an air-raid warning.

The manufacturers are:—Hills Patent Glazing Co., Ltd., Albion Road, West Bromwich.

## Macrome Toughening

DELIVERY of drills, taps, saws, screwing dies, reamers and other small tools has become somewhat of a problem to-day, and it is useful to know of any means whereby to alleviate the position. To increase the output would be one way; another is to extend the life of those already made. Macrome, Ltd., claim that tools which have been subjected to their toughening process last at least twice as long as ordinary tools and will give double the output for each regrind. The treatment is applied to cutting tools when they are normally regarded as ready for use, and its effect is to toughen the tools throughout. Comparative tests have been carried out with some interesting results. Here are some typical instances. A shipyard drilling "D" quality $\frac{7}{8}$in. steel and using first their standard 25/32in. H.S.T.S. twist drills, untreated, did 450 holes with three drills which were then badly worn. Two similar drills, Macrome treated, did 3,600 holes under the same circumstances and then only required grinding. In an aircraft factory screwing dies were tested, the normal output per regrind was about 1,000 components when using untreated dies; this rose to over 7,000 when Macrome toughened dies were used. The treatment is carried out by Macrome, Ltd., Hay Mills, Birmingham, who will gladly arrange a free comparative test to convince those who feel it is too good to be true.

## Works Passes

IT is essential in these days to issue a works pass to all employees and at the same time make it as difficult as possible to forge or use a genuine pass which has been lost. The well-known photographic concern of Miles and Kaye, 54, Cheapside, London, E.C.2, have devised a pass in which both the wording and the portrait appear on the same photographic base, that is to say, the wording and portrait are one photograph and not just a portrait mounted on a letterpress base. As a week to week check it is suggested that passes should be shown at the time of drawing wages.

Miles and Kaye's method is to send an operator to a works desiring this style of pass to take individual photographs of the employees, and this can be organised in such a way that as many as 500 photographs a day can be taken. The standard sizes of the passes are approximately 4¼in. by 3¼in. and 3¼in. by 2¼in. and various transparent coverings may be had.

### ANSWERS

*Below we give the answers to the Test Questions on page 378.*

1. Yes. In the De Havilland Albatross.
2. National Advisory Committee for Aeronautics.
3. Yes. The Dutch Koolhoven FK 58.
4. Miss Amelia Earhart. (Mrs. Putnam).
5. Napier Dagger VIII. (4,200 r.p.m. maximum).
6. One Vickers gun and one Lewis gun.
7. Blohm and Voss of Hamburg.
8. Nineteen.
9. Increase in angle of incidence toward the wing-tip.
10. The Irvin made by the Irving Air Chute of Great Britain Ltd.
11. An aircraft in which support in flight is derived dynamically from the reaction on surfaces in motion relative to the air.
12. Hornet.

# THE INDUSTRY

## British Timken Appointments

MR. MICHAEL DEWAR, chairman of British Timken, Ltd., the Birmingham manufacturers of ball, roller and tapered-roller bearings, and Mr. F. J. Pascoe, financial director of British Timken, Ltd., have been elected to the board of Fischer Bearings Company, Ltd., Wolverhampton.

Mr. J. E. Spear, previously sales manager, engineering division of British Timken, Ltd., has now been placed in charge of a new department which will be responsible for planning, control, and progressing of production. Before being appointed engineering division sales manager a year and a half ago, Mr. Spear was railway representative.

## "O Wad Some Power . . ."

IN our issue of March 28 we gave particulars of the Onan O.T.C. electric generating sets which are specially designed for use in aircraft. It is interesting to learn that one of these units was used for an aircraft-television experiment in the U.S.A. a short while ago.

A United Air machine, 21,000 feet over Washington, had in its cabin a television receiver taking the broadcast from Radio City some 200 miles away. Later, as the aircraft circled and landed at New York, the picture on the screen was of the machine itself landing. This was only a stunt show, but the possibilities for the future are enormous. For military observation or, when allied to infra-red rays, for blind landings, its use can be readily understood.

B.M.B. Manufacturing Co., Ltd., Britannia House, Ampton St., London, W.C.1, handle the Onan sets in this country.

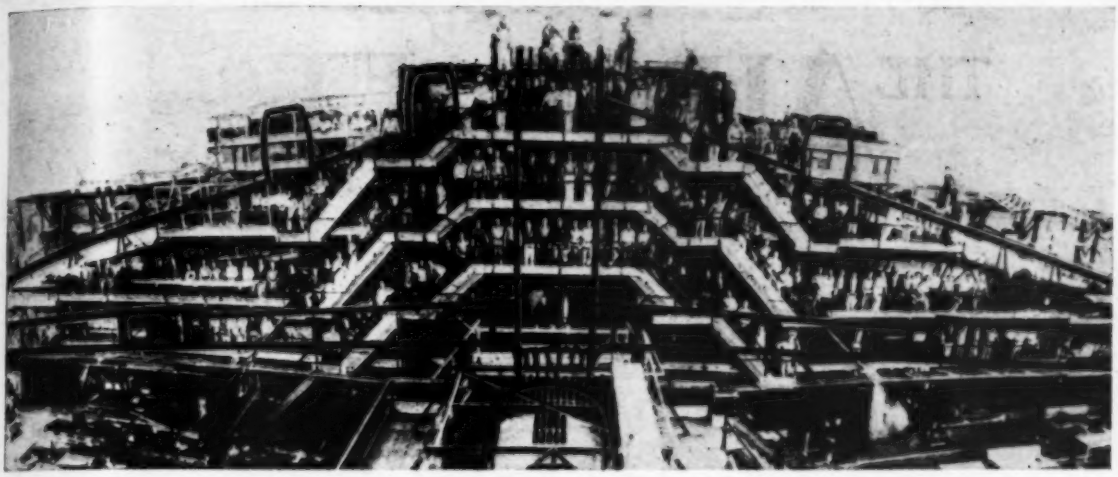
## Aluminium Working Advice

OWING to war contracts many engineering concerns find themselves engaged on work far removed from their normal production. For instance, the sub-contracting scheme of the aircraft industry alone is responsible for a vast number of firms being employed in working aluminium and its alloys who, prior to the war, had no experience of it.

For these the Northern Aluminium Co., Ltd., have a Technical Advisory Service, operating from their headquarters at Banbury, whose job it is to offer, free of charge, expert advice on all problems concerned with the working and treatment of aluminium and its alloys.

Provided that authoritative advice is sought, no metal-working firm of standing need fear embarking on the manipulation of light alloys. The Technical Advisory Service has at its disposal considerable resources in the way of knowledge concerning, and experience in working, a range of products which embraces materials for all purposes for which light alloys are suitable.

Its advice has already been sought on a variety of intricate problems concerned with casting and foundry technique, die design and die-casting procedure, heat treatment, forging and stamping, machining, jointing and protection from corrosion.



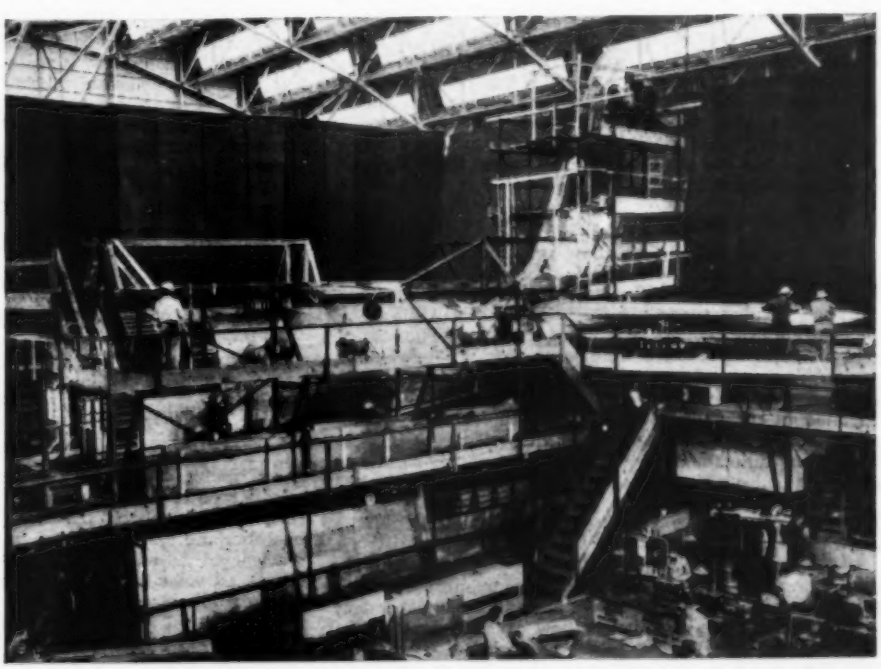
The working platforms which are being used for the construction of the vast wing of the Douglas B19. Following usual modern procedure, the wing is being built in the vertical position, and its outline is shown superimposed on the photograph.

# WORLD'S LARGEST BOMBER

## *America's 210 ft. Span Giant*

INFORMATION has been released by the U.S. War Department relating to the very large bomber, known as the B19, being built by the Douglas Aircraft Company at Santa Monica. Its gross weight of approximately 70 tons (157,000 lb.) will make it easily the largest aeroplane ever built, and with its wing span of 210ft. it should be an impressive sight. Its speed, with four engines totalling about 6,000 h.p., is given as 200 m.p.h. Its airscrews will be three-bladed constant-speed of 16 ft. diameter, and the undercarriage will be of the nosewheel type. The figure of 28 tons given for its disposable load (fuel, crew, and military load) is 40 per cent. of its loaded weight and is above the corresponding figure for commercial transports of latest design. The Lockheed Lodestar shows 33.7 and the Douglas DC3 a ratio of 32.7 per cent., which makes one a little sceptical of the 40 per cent. of the very much bigger B19. One is even more sceptical of its value as a military weapon, considering its very great cost and its very great vulnerability to gunfire. Its power loading of about 26 lb./h.p. seems very high, and does not augur a good take-off and climb. One wonders if there is thought of refuelling in the air.

Some idea of the size of this giant bomber—the name is for once justified—can be obtained by comparing its dimensions with those of our biggest air liner, the Ensign, whose span is 123ft. and gross weight 48,500 lb. The Dornier DoX had a span of 157ft. and gross weight of 123,000 lb., with a power of 7,200 h.p. The contract for the construction of the B19 was signed some five years ago.



The rear section of the fuselage of the Douglas B19 bomber, under construction in the company's Santa Monica works. With a wing span of 210ft. and a gross weight of 70 tons, it will dwarf all other aircraft. The colossal proportions of the single fin may be seen, and the tailplane appears as large as the wing of many a transport aeroplane. There appears to be a circular turret opening in the top of the fuselage. Note the screens hung from the roof for secrecy

THE AIRCRAFT ENGINEER

No. 171. (Volume XIX No. 3) 15th Year April 25, 1940

# TURBO-SUPERCHARGERS

## *Some Notes on Their Design and Construction*

By F. UMPLEBY

(*Continued from page 12, March 28, 1940*)

Of the two conventional types of turbine shown in Fig. 2, the impulse type is the one usually used for turbo-supercharging. The developed view of its blades projecting radially from the rim of the turbine wheel shows their shape and pitch. At the bottom, two thin crescent-shaped blades of early but now obsolete design will be noted, and the fluid flow lines around these blades in the direction shown by arrow heads indicates how the driving fluid crowds towards the back of the blade, leaving a zone of turbulent flow in front of the blade.

Since the fluid flows through the blades at a speed of the order of the speed of sound it will be realised that it is essential to maintain streamline flow in the blade passages if the efficiency of the turbine is to be of a high order. Streamline flow is attained as shown by adding metal to the front of the blade, and this gives a stiffer form of blade.

The nozzles from which the jets of fluid enter the blades are set at an angle of 15 to 20 deg. to the rim of the wheel and the path of the fluid is changed through an angle of about 250 deg. before it emerges from the wheel on the exhaust side. Thus two kinds of energy are utilised in driving the turbine, the kinetic energy of fluid velocity, and the reaction effect due to the change in the direction of fluid flow in the blade passages. The most efficient velocity for the blade in the impulse type is about half the velocity of the fluid emerging from the nozzles, therefore the rotational speed of the turbine wheel will depend upon the mean pitch diameter of the turbine blades. The larger the wheel the less the rotational speed, the peripheral speed remaining constant.

### *Fundamental Theory*

The direction of the fluid flow in the nozzle as represented by its centre line shows the direction of the forces applied to the blades, and where it enters the blade shows the point of application. Also, a length scaled off along the centre line shows the velocity of the fluid. Thus direction, point of application, and magnitude of the driving force are known. These are shown in Fig. 2 by V, for a velocity of 1,500 ft./sec. Next a line is laid off in the direction of turbine wheel rotation with length to represent 750 ft./sec., which gives the most efficient wheel-to-fluid speed ratio for an impulse turbine, and is shown as Vb. The end of this line is now joined up to the point of entry of the fluid into the wheel by the line $V_R$, which represents the relative velocity of the fluid entering the blade passages.

If we neglect all losses in the blade passages due to gas friction, the fluid will emerge on the exhaust side with the same speed that it entered them, at an angle dependent upon the change in direction of flow caused in the blade. This is shown by $V_{R_2}$ the relative velocity of emergence. Combining this again with wheel velocity Vb, we get the actual speed and direction of the emerging fluid, shown by $V_2$.

When $V_2$ is at right angles to Vb, the energy absorbed in the wheel is a maximum and the turbine is operating at its maximum efficiency. The theoretical horse power of the turbine per pound of fluid, under these conditions is:

$$\text{Power} = \frac{Vb\ (V_1 \cos \alpha + V_2 \cos \beta)}{550\ g}$$

This power is not actually obtainable due to various losses, but about 80 per cent. may be obtained in an efficient design.

The efficiency of the turbine is decreased if the driving fluid is thrown out of the wheel by centrifugal force without doing work, this loss being increased if blade-tip clearance is excessive, as is the case in the conventional type of turbo-supercharger running at low altitude.

One of the most efficient steam turbines is the multi-stage Ljungström turbine, in which the driving fluid flows radially outwards from the centre through rings of blades rotating in opposite directions, so utilising all changes in the direction and momentum of the fluid as driving forces. This can be appreciated if the compressor design shown in Fig. 8 be regarded as a turbine in which the set of fixed blades in the centre were to rotate in the opposite direction to the two sets of moving blades. The efficiency of this turbine is largely due to the high velocity of the fluid between the blades, but it is also due in a large measure to the reduction in leakage loss over the blade tips, since in order to pass from the inlet to the exhaust side the fluid must do some work in one or the other set of blades. These remarks hold good to a considerable extent for the ballistic velocity turbine. Of the two methods of turbine operation open to us for turbo-supercharging the "pressure velocity head" method has been generally used in the past.

### *Gas Oscillations*

As we have seen, by this method it is necessary to have a head of fluid pressure, to obtain which in a turbo-supercharger the area of the turbine nozzles are restricted in such a way that they reduce the free flow of the exhaust gases, and create a back pressure of a few pounds per square inch in the exhaust system. Furthermore, we have seen that this back pressure overheats the combustion chamber and exhaust valves, and decreases the volumetric efficiency. As an alternative to the conventional "pressure head velocity" method a purely "velocity" method of operation may be used, which at once creates a more favourable set of conditions. Kadenacy* and his co-

* "Two-Stroke Aero-engines," by F. Umpleby, *Flight*, Feb. 24, 1938.

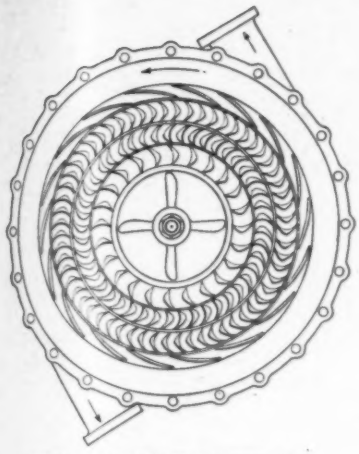
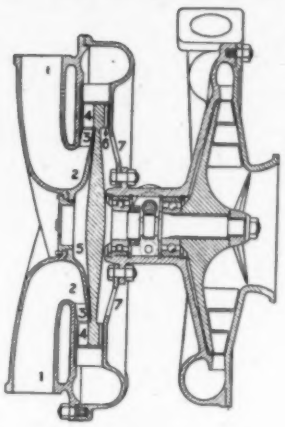
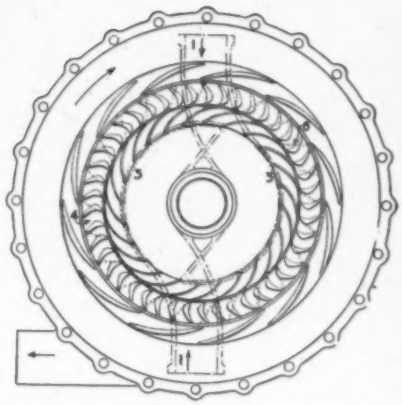


Fig. 9. A multi-stage compressor.





Figs. 3 (centre) and 4 (right) show two views of the ballistic velocity radial-flow turbo-supercharger.

workers in research have established that once the exhaust port or valve is opened practically half the exhaust gases leave the cylinder with a velocity of the order of the speed of sound.

Clearly, then, we have here the gas velocity required to operate the turbine, and there is no necessity to convert this velocity to a pressure head before reaching the turbine nozzles and then reconvert the pressure head back to a velocity of the order of its original magnitude. In addition, Kadenacy found that this ejection of the exhaust gas at ballistic velocity was followed by a depression with the residue of the exhaust gas in the combustion chamber moving rapidly towards the exhaust outlet, and at the same time a series of gas oscillations occurred in the exhaust pipe system. From this it is quite evident that in a four-stroke engine, where the exhaust valve remains open for the usual period, high-temperature exhaust gases may flow past the exhaust valve in both directions several times before it closes.

## *Ballistic Velocity Turbine*

In my patented design of "ballistic velocity turbine" the exhaust gases are directed into a radial outward flow turbine with a minimum of loss in their velocity, and further, the turbine blades are extended outwardly so as to act as centrifugal exhauster blades (see Figs. 3, 4, 6 and 7). With this method of operation an annular zone of accelerated outward gas flow is created around the turbine wheel, the depression in the exhaust pipe and system is maintained and prolonged, and return surges of gas and gas oscillations in the exhaust pipes are eliminated. Furthermore, the exhaust gas back pressure is eliminated, the temperature of the combustion chamber and exhaust valve are reduced, and more room is provided in the cylinder for a greater and denser charge of clean, fresh air or combustible mixture.

In the turbine as illustrated in Figs. 3 and 4, the exhaust gases enter the turbine direct by way of pipes (1) and passages (2), and the jets of gas to drive the turbine leave the convergent nozzles (3) at an angle of 16 deg. to impinge on the turbine blades (4). In the passages between the blades the path of gas flow is changed and it finally emerges from the blades almost radially. The exact exit angle is determined by the path of gas flow in the blade passages, the peripheral velocity of the wheel, and the angle at the tips of the exhauster section of the blades. It must not be thought, however, that the annular zone of accelerated outward gas flow around the turbine wheel is gained without expense, as part of the power output of the turbine is absorbed in the process. The curved convergent nozzles (3) are segments of a tube welded to the disc (5), and the turbine blades (4) are designed to give streamline gas flow through the blade passages by combination of the elements shown in Figs. 2 and 8. They are machined from the solid metal of the rim of the turbine wheel, an exact but not difficult operation. Being solid with the rim, they provide an easy path for heat flow to the rim.

We may now consider methods of cooling the blades and rim of the turbine. The top blade on the left of Fig. 2 shows the formation of one of a number of similar blades cooled by means of air passed through the interior compartments of the blade. In addition, tests were performed with the turbine wheel and blades partly exposed to the slipstream. The results indicated that the turbine could be almost sufficiently cooled by these two methods in combination.*

Recently Junkers have taken out a British patent in which they propose to cool the turbine by means of air taken from the delivery by the centrifugal air compressor. In the Büchi system, as applied to four-stroke compression ignition engines, the turbine is cooled by means of air supplied by the supercharger. This flows through the inlet valve port by way of the combustion chamber,

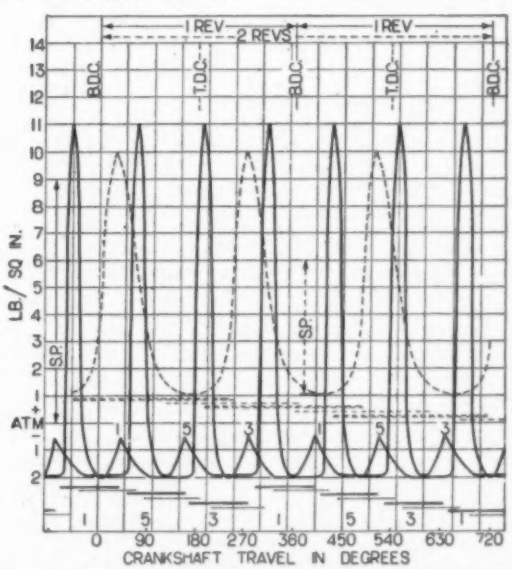
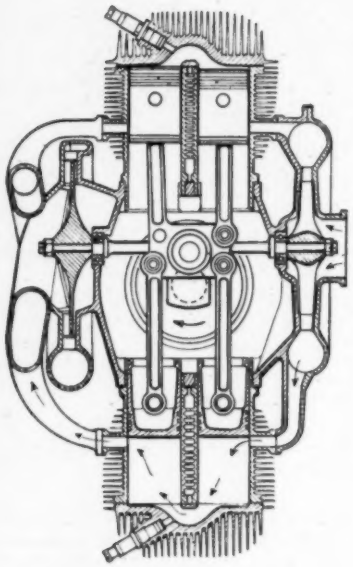
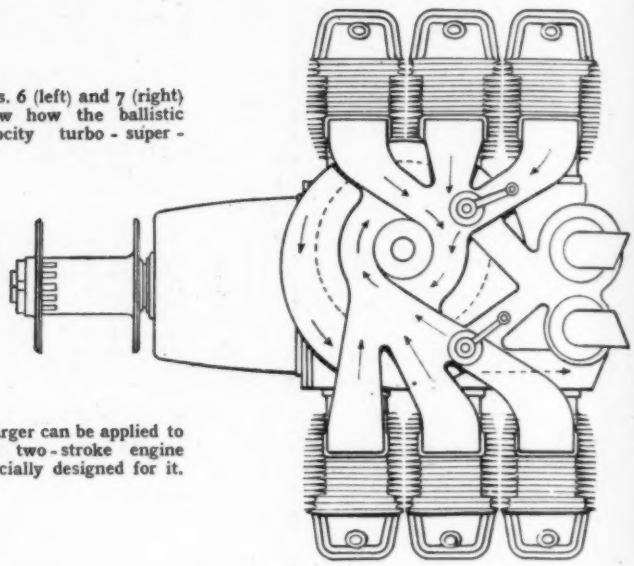



Fig. 5. Pressures in exhaust pipes. Full lines apply to two-stroke engine with ballistic velocity turbo-supercharger; dotted lines to the Büchi system on a four-stroke compression-ignition engine.

* "The Work of the DVL," by Dr. F. Seewald, *Flight*, Nov. 24, 1938.





Figs. 6 (left) and 7 (right) show how the ballistic velocity turbo-supercharger can be applied to the two-stroke engine specially designed for it.

through the exhaust valve port into the exhaust port, and thence to the turbine.

Fig. 5 shows, in dotted lines, how the gas pressure varies in the exhaust pipe in this system. Three cylinders are connected to each exhaust pipe in this case.*

It will be noted from Fig. 5 that, within 80 deg. of crankshaft travel after the exhaust valve has opened, the pressure in the exhaust pipe has reached about 11 lb./sq. in. that it decreases rapidly to 3, and then more slowly to 1 lb./sq. in. Thus the minimum pressure in the exhaust pipe is of the order of 1 lb./sq. in. for 70 deg. of crankshaft travel at the period when both inlet and exhaust valves are open at the same time, and the scavenge air flows right through the combustion chamber into the exhaust pipe under the influence of the 5 lb./sq. in. pressure created by the supercharger.

### *Turbine Design*

It is evident that under these conditions the turbine must withstand the first blast of maximum temperature exhaust gas which is followed by a blast of cooler, but nevertheless hot, mixture of gas and air. The double-dotted lines in Fig. 5 below the dotted pressure curves show the period the exhaust valves are open in crankshaft degrees. The single dotted line shows the period when the inlet valves are open. Where these two lines overlap indicates the period for which both valves are open simultaneously, 120 deg. of crankshaft travel.

Turning now to Figs. 3 and 4, it will be noted that on the writer's design of turbine, exhauster blades are provided at (6) which draw a stream of air by way of openings (7) over the rim of the turbine wheel, thus cooling it. Returning now to Fig. 5, the full-line curves indicate the pressures that may exist in the exhaust pipe of a two-stroke engine (constructed as shown in Figs. 6 and 7), when scavenged and supercharged by the writer's design of turbo-supercharger (shown in Figs. 3, 4 and 6) with three cylinders connected to each exhaust pipe. It will be noted that the exhaust port opens 72 deg. before bottom dead centre, and that within 12 deg. of crankshaft travel the pressure in the exhaust pipe has reached about 11 lb./sq. in. Within 40 deg. the pressure has fallen below atmospheric, due to the ejection of the exhaust at ballistic velocity, and the pressure continues to fall until at B.D.C. there is a depression of 2 lb./sq. in.

The exhaust port period and timing are shown by the double full lines below the pressure curves, and the inlet by the single full line. Comparing these with the pressure curves, it will be seen that the pressure on the induction side due to the supercharger manifests itself as an increase in pressure in the exhaust pipe just after B.D.C. Pressure increases as long as the exhaust port is open. When the exhaust port closes the pressure in the pipe falls to the depression maintained by the turbo-exhauster-supercharger until the next exhaust port opens. In this case, for a six-cylinder engine with opposed cylinders, number three cylinder is the next to exhaust into the exhaust pipe under consideration. It is followed by number two, the firing order for the engine being 1, 5, 3, 4, 2, 6.

*(To be continued.)*

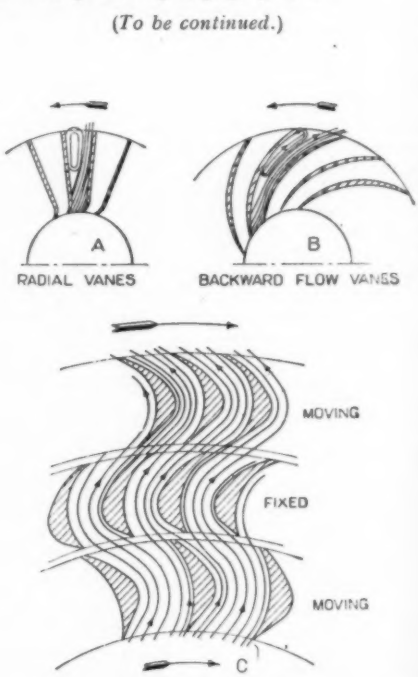



Fig. 8. Designs of centrifugal compressors. In A and B the air becomes turbulent behind the blades, but the design shown in C avoids this.

* "Increasing the Power of Diesel and Aeroplane Engines," by E. Kingelfuss.

# FLIGHT
and The AIRCRAFT ENGINEER

*First Aeronautical Weekly in the World : Founded 1909*

*Editor* C. M. POULSEN

*Managing Editor* G. GEOFFREY SMITH

*Chief Photographer* JOHN YOXALL

Editorial, Advertising and Publishing Offices: DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1

**Telegrams: Truditur, Sedist, London.** **Telephone: Waterloo 3333 (50 lines).**

| 8-10, CORPORATION ST., COVENTRY. | GUILDHALL BUILDINGS, NAVIGATION ST., BIRMINGHAM, 2. | 260, DEANSGATE, MANCHESTER, 3. | 26B, RENFIELD ST., GLASGOW, C.2. |
|---|---|---|---|
| *Telegrams:* Autocar, Coventry. *Telephone:* Coventry 5210. | *Telegrams:* Autopress, Birmingham. *Telephone:* Midland 2971 (5 lines). | *Telegrams:* Iliffe, Manchester. *Telephone:* Blackfriars 4412. | *Telegrams:* Iliffe, Glasgow *Telephone:* Central 4857. |

SUBSCRIPTION RATES: Home and Canada: Year, £2 6 0. 6 months, £1 3 0. 3 months, 11s. 6d.
Other Countries: Year, £2 9 0. 6 months, £1 4 6. 3 months, 12s. 3d.

No. 1636. Vol. XXXVII. MAY 2, 1940 Thursdays, Price 9d.


# The Outlook

## *Fighters in Norway*

THE British troops in Norway must have hailed with great delight the arrival of some fighter aircraft. Before they came the bombers of the *Luftwaffe* had had it all their own way, and to be bombed without a chance of hitting back is a heavy test of steadiness in soldiers. It is also no light test of adaptability for the fighters to establish themselves on a frozen lake as an aerodrome, where they too had to undergo a dose of bombing, and had some machines damaged. Evidently they did not take long to make their presence felt, and, as a result of their doings and the efforts of the anti-aircraft guns which have also been landed, fourteen German aircraft have been shot down or damaged. Since then all the reports speak of a much greater degree of circumspectness on the part of the German bombers.

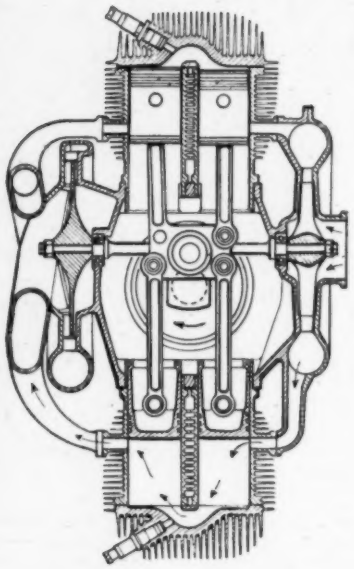
This anti-bomber defence was one of the first great needs of the Expeditionary Force, but another urgent need must be reconnaissance aircraft. An army always needs information, but it has especial need for it in mountain warfare. Capt. Macmillan comments on this aspect of the campaign in the article which we publish on another page. We think that he is rather severe in blaming the Air Ministry for not having foreseen and provided for a campaign in Norway, because seven months ago nobody but a clairvoyant could have been expected to foresee it. Without foreseeing such a situation, there would not have seemed much reason for providing numbers of floatplanes for army co-operation work, and yet now the N.W.B.E.F. must be longing for floatplanes which could work from the fjords and tell the staff what is on the other side of any number of hills. The fighters will doubtless do what they can to help, though fighter pilots have not been trained for that sort of work, and perhaps the versatile Coastal Command, whose observers are trained to use their eyes, though ships rather than troops are what they are expected to spot, will give a hand. It should not be impossible to send trained army co-operation pilots as observers in Coastal Command aircraft. We have no doubt that the Air Staff men are using their active wits to devise means for giving the N.W.B.E.F. all the air help which it has so badly needed.

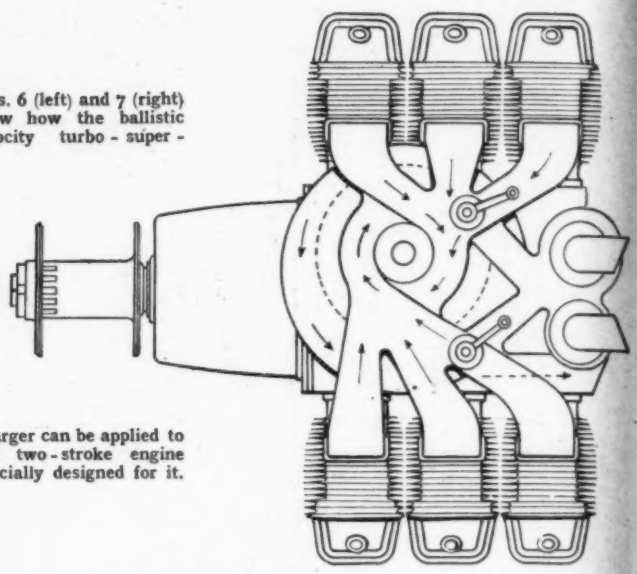
## *No Atlantic Service*

THE last faint hopes for a North Atlantic service this summer, which might have been lingering in some people's minds, were finally dispelled by Captain Balfour's announcement that *Caribou* and *Cabot* are to be retained on their military work. These boats are the only two suitable for the transatlantic route, as the three "G" class boats, though they have flown, are not quite ready. So Britain will not be seen on the broadest of the ocean highways this year.

It is not a general deficiency of aircraft which causes these two boats to be taken off the work for which they were designed and built, for our factories are turning out thousands. But military design for Coastal Command work has lagged far behind, and so has caused the production of aircraft specifically intended for Coastal Command duties to lag also. Nearly all the craft engaged on these duties today are converted civil types. The Lockheed Hudson was first an airline machine, operating in numbers. The Avro Anson was also a civil design taken and adapted for military purposes. The Sunderland was specially designed, but owes much to the Empire boat.

The situation is not one for congratulation, but we must do the best with it and be reconciled to the loss of economic advantages, operating experience and





Figs. 6 (left) and 7 (right) show how the ballistic velocity turbo-super-charger can be applied to the two-stroke engine specially designed for it.

through the exhaust valve port into the exhaust port, and thence to the turbine.

Fig. 5 shows, in dotted lines, how the gas pressure varies in the exhaust pipe in this system. Three cylinders are connected to each exhaust pipe in this case.*

It will be noted from Fig. 5 that, within 80 deg. of crankshaft travel after the exhaust valve has opened, the pressure in the exhaust pipe has reached about 11 lb./sq. in. that it decreases rapidly to 3, and then more slowly to 1 lb./sq. in. Thus the minimum pressure in the exhaust pipe is of the order of 1 lb./sq. in. for 70 deg. of crankshaft travel at the period when both inlet and exhaust valves are open at the same time, and the scavenge air flows right through the combustion chamber into the exhaust pipe under the influence of the 5 lb./sq. in. pressure created by the supercharger.

### *Turbine Design*

It is evident that under these conditions the turbine must withstand the first blast of maximum temperature exhaust gas which is followed by a blast of cooler, but nevertheless hot, mixture of gas and air. The double-dotted lines in Fig. 5 below the dotted pressure curves show the period the exhaust valves are open in crankshaft degrees. The single dotted line shows the period when the inlet valves are open. Where these two lines overlap indicates the period for which both valves are open simultaneously, 120 deg. of crankshaft travel.

Turning now to Figs. 3 and 4, it will be noted that on the writer's design of turbine, exhauster blades are provided at (6) which draw a stream of air by way of openings (7) over the rim of the turbine wheel, thus cooling it. Returning now to Fig. 5, the full-line curves indicate the pressures that may exist in the exhaust pipe of a two-stroke engine (constructed as shown in Figs. 6 and 7), when scavenged and supercharged by the writer's design of turbo-supercharger (shown in Figs. 3, 4 and 6) with three cylinders connected to each exhaust pipe. It will be noted that the exhaust port opens 72 deg. before bottom dead centre, and that within 12 deg. of crankshaft travel the pressure in the exhaust pipe has reached about 11 lb./sq. in. Within 40 deg. the pressure has fallen below atmospheric, due to the ejection of the exhaust at ballistic velocity, and the pressure continues to fall until at B.D.C. there is a depression of 2 lb./sq. in.

The exhaust port period and timing are shown by the double full lines below the pressure curves, and the inlet by the single full line. Comparing these with the pressure curves, it will be seen that the pressure on the induction side due to the supercharger manifests itself as an increase in pressure in the exhaust pipe just after B.D.C. Pressure increases as long as the exhaust port is open. When the exhaust port closes the pressure in the pipe falls to the depression maintained by the turbo-exhauster-supercharger until the next exhaust port opens. In this case, for a six-cylinder engine with opposed cylinders, number three cylinder is the next to exhaust into the exhaust pipe under consideration. It is followed by number two, the firing order for the engine being 1, 5, 3, 4, 2, 6.

*(To be continued.)*

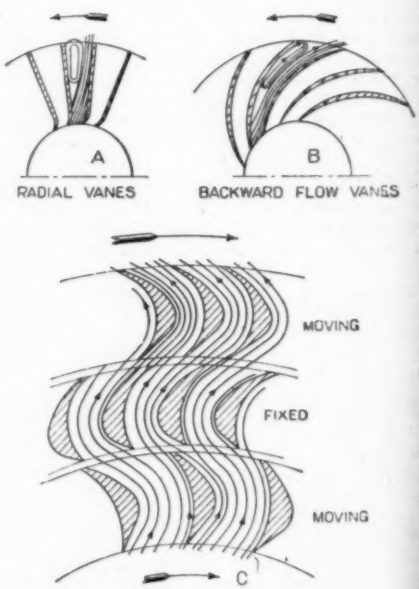
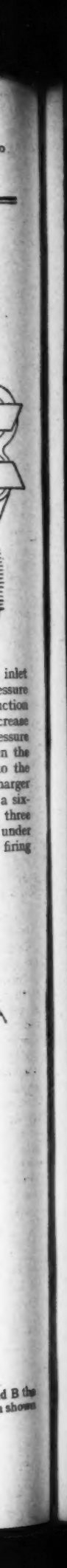



Fig. 8. Designs of centrifugal compressors. In A and B the air becomes turbulent behind the blades, but the design shown in C avoids this.

* "Increasing the Power of Diesel and Aeroplane Engines," by E. Kingelfuss.